Undergraduate Research Experience
Faculty of Science
University of Alberta

I. Introduction

Although we have not received reports from all seven departments in the Faculty, it is safe to assume that the Faculty of Science places high priority on linking research and teaching for undergraduate students. This philosophical framework is based on significant incorporation of undergraduate students in research programs that involve individual faculty members, our course programs, summer and term research programs, and special events and extra-curricular initiatives. Herein a description of the variety of learning experiences available to the undergraduate student in as illustrated in this report.

II. Courses:

There are many courses in the Faculty of Science that contain research experience for the undergraduate student. Here a selection from:

1) Department of Biological Sciences project/honors courses [those in **bold** are new courses or existing courses redesigned with research components since 2001].

Course	Short Title	Enrolment	Independent Research Project	Data Collection/ Analysis	Oral Presentation Results	Written Research Report
Bioinformatics 401	Bioinformatics II	7	Yes	Yes	No	Yes
Biology 208	Principles of Ecology	729	Yes	Yes	No	Yes
Biology 299	Undergraduate Research Opportunity	New Course	Yes	Yes	No	Short Report
Biology 333	Wetlands Ecology & Management	30	No	Yes	No	Yes
Biology 335	Principles of Systematics	63	Yes	Yes	No	Yes
Biology 391	Techniques in Molecular Biology & Bioinformatics	19	Yes	Yes	No	Yes
Biology 430	Experimental Biology	37	Yes	Yes	No	Yes
Biology 464	Limnology	8	No	Yes	No	Yes
Biology 470	Landscape Management	15	Yes	Yes	Yes	Yes
Biology 498	Research Project	18	Yes	Yes	No	Yes
Biology 499	Honors Research Project	67	Yes	Yes	Yes	Yes
Botany 306	Biology of the Fungi	11	Yes	No	No	Yes
Botany 322	Field Botany	7	Yes	Yes	Yes	Yes
Botany 332	Plant Ecology	58	Yes	Yes	Yes	Yes
Entomology	Insect	56	Yes	Yes	No	Yes

378	Pathology	(optional)				
Entomology 427	Insect Taxonomy	8	No	Yes	No	Yes
Genetics 420	Research in Molecular Genetics	20	No	Yes	No	Yes
Marine Sciences 403	Directed Studies in Marine Sciences	5	Yes	Yes	Yes	Yes
Microbiology 345	Microbial Laboratory Techniques	24	No	Yes	No	Yes
Microbiology 450	Fermentation Biotechnology	5	Yes	Yes	Yes	Yes
Zoology 344	Laboratory Exercises in Animal Physiology	29	Yes	Yes	Yes	Yes
Zoology 351	Freshwater Invertebrate Diversity	8	Yes	Yes	No	No
Zoology 354	Wildlife Diseases	20	Yes	No	Yes	Yes
Zoology 370	Ethological Mechanisms	40	Yes	Yes	No	Yes
Zoology 371	Behavioural Ecology	78	Yes	Yes	No	Yes
Zoology 434	Field Course in Animal Ecology	9	Yes	Yes	Yes	Yes
Zoology 452	Experimental Parasitology	10	Yes	Yes	No	Yes
Zoology 552	Advanced Parasitology	6	Yes	Yes	Yes	Yes

Current Topics Discussion Courses

Several Honors and Specialization Programs in the department require students to complete a graded current topics/discussion/seminar course in which the focus is on discussion and critique of current primary research articles, and to develop scientific and research thinking abilities.

Such courses offered within the past 2 years include

Course	Title	Enrolment
BIOL 364	Freshwater Ecology	38
BIOL 433	Plant-Animal Interactions	11
BIOL 468	Problems in Conservation Biology	22
BOT 384	Global Change and Ecosystems	19
ZOOL 402	Current Topics in Developmental Biology	19
ZOOL 441	Current Topics in Homeostasis	15
ZOOL 442	Current Topics in Intercellular Communication	14

- A new course BIOL 495 (Special Topics in Biology) will be added in 2004/05.

2) Department of Chemistry

- **CHEM 401 Introduction to Chemical Research**
  Normal enrolment approximately 7 - 10 students. Currently this is an option course for students in the Honours and Specialization programs, but either this course or CHEM 400 (see below) will be a requirement for the Honours students as of Fall 2005. The course involves research experience with a faculty member and requires approximately 8 hours/week. It is taken in the final year of the program. In addition, this research course involves a written report and a final oral presentation that is given to an audience of undergraduate students, graduate students and academic staff. Instruction is given to the students to help them prepare for the oral presentation.

- **CHEM 403 Chemical Research**
  Normal enrolment is about 2 - 4 students. This is an extension of Chem 401 and involves a second term of research after completion of one term of Chem 401. This course is optional for Chemistry Honours and Specialization students. The time commitment and the requirements for a written and oral report are the same as for Chem 401.
  As a result of research done during the 401/403 courses, students have co-authored at least 9 publications and given at least 9 presentations at conferences in 2002/2003 and at least 3 publications and 3 presentations in 2003/2004.

- **Chem 400 Industrial Internship Practicum**
  This course involves writing a report and giving an oral presentation of results of research done as part of the student's Industrial Internship in the previous year. The normal enrolment is 7 - 10 students/year. In the past year alone, students have given 2 conference presentations.

- **Chem 493 Computational Chemistry**
  Enrolment approximately 10 - 15 students/year. This is a one-term course in which the first half is devoted to lectures on the state-of-the-art computational techniques needed in Chemistry. In the second half of the course each student submits a research proposal, then after approval and suitable discussion with the instructor, carries out the necessary computational research on their proposal. Students use either their own computers or make use of the computer facilities in W1-50 in the Chemistry Department. A written report and an oral presentation are required.
  A number of upper level undergraduate courses involve a component in which reports are written or oral presentations are made based on a review of the chemical literature. This would involve about 5 - 10 students/year.

3) Department of Computing Science

- **CMPUT 499**. This is a designated course number at the 400 level for independent studies courses. These are directed readings and research courses undertaken by joint agreement between a faculty member and some students. These courses often have a project requirement and typically involve reading current research articles from conference proceedings and scholarly journals. The format often includes weekly discussion meetings, in which research issues are dissected and discussed. During the four academic terms from Fall 03 to Winter 04 inclusive, nine such independent studies courses were taught, involving seven different faculty and 16 students.

- The Computing Science curriculum requires that students enroll in a minimum number of 'project' courses, in which students form teams and often tackle a significant computing problem.

  Examples of these courses are **CMPUT 466 (Machine Learning) and CMPUT 412 (Experimental Robotics).**

  It is typical for assignments in advanced courses (third and fourth year) to be connected to current research issues or techniques with which faculty are familiar.

II. Courses (cont. - special program – Industrial Internship Program)

The Industrial Internship Program formally integrates a student's university education with work experience in co-operating employer organizations. It offers undergraduate students, between the third and fourth year of study, paid work experience in a corporate setting. The internship is a continuous single-work period of 8, 12, or 16 months with industry or agency.

In some Faculty of Science departments (*e.g*., Biological Sciences), this program demands a research component, while others (*e.g*,. Computing Science) provide "hands-on" real world experience in the work force.

During the academic year, the interns are registered as full-time, off campus students and have faculty advisors. On return to the University, each student in all Departments (*e.g*., see Chem 400 IIP Practicum above) takes a credit course in which they provide written and oral reports on their research/work experiences. Approximately 100 students from the Faculty are in the program each year and several research publications in refereed scientific journals often result.

III. Public Forums/Events:

Department of Biological Sciences

- Research Days

  This annual 2-day event is largely for graduate students, but undergraduates are encouraged to participate.

  Organized by students

Internationally renowned scientist is special guest and "keynote speaker" - fully advertised across campus
Poster presentations of student research
Oral sessions of student research

■ PUBS (Prairies University Biology Seminars)
An annual international scientific meeting for senior undergraduate and graduate students held at universities in the "Prairies" (including Northern Plains in US and Western Canada).
U of A hosted the event in 2004 with ~250 participants;
To- or three-day event with student presentations and keynote speaker
Organized mainly by graduate students, but undergraduate researchers are also involved

■ Seminar Series
Numerous series of research seminars offered, to which many undergraduate students are invited and attend.

Department of Chemistry

■ The "Western Canada Undergraduate Chemistry Research Conference" was started by the Department of Chemistry at the University of Alberta and involves all Canadian Universities between Thunder Bay, ON and Victoria, BC. The location of this annual conference rotates amongst the participating universities. Students give either oral or poster presentations on original chemistry research carried out while they were undergraduate students, and can involve either academic or industrial research. Typically, the department sends 10 - 20 students to this conference each year. Individual research supervisors and a significant departmental contribution cover costs.

■ Recently, the "National Undergraduate Chemistry Conference" has been initiated by the University of Ottawa and is held in Ottawa each year. Chemistry sends 0 - 2 students to this conference each year, but the distance and timing (early October) make it difficult to encourage student participation.

■ The two pre-eminent national chemistry conferences in North America are the American Chemical Society Conferences (held semi-annually) and the Canadian Society for Chemistry Conference and Exhibition (held annually). Depending on the location, the Chemistry department sends 0-5 undergraduate students per year.

■ One faculty member in Chemistry, Glen R. Loppnow, is a member of the RISE (Reactive Intermediates Student Exchange) program, in which 1 - 2 students from the University of Alberta perform research at other participating universities in Canada. At the end of the summer, all of the students in Canada gather at one of the Universities for a mini-conference and present the

results of their research. In 2003, this mini-conference was a part of the national CSC Conference.

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IV. Undergraduate Teaching

Policy on teaching release for faculty members: When proposals are put forward for externally funded chairs, there is typically a concrete specification for a reduced teaching load, but all faculty members teach.

Undergraduate teaching by holders of endowed research chairs:

Department of Biological Sciences

Killam Chair: Dr. David Schindler teaches mainly graduate courses, but is a significant role model for undergraduates.

Alberta Conservation Association Chair: Dr. Mark Boyce teaches Population Ecology (BIOL 331; enrolment 54)

NSERC Industrial Chair: Dr. Stan Boutin teaches the Field Course in Animal Ecology (ZOOL 434: enrolment 9)

Canada Research Chairs:

Dr. Neil Adames (CRC Molecular Genetics) participates in the team teaching of two undergraduate courses, GENET 301 (Organization of simple genomes) and GENET 304 (Gene expression and its regulation) with enrolments of 102 and 98, respectively.

Dr. David Hik (CRC Northern Ecology) is currently on sabbatical but has been assigned to teach part of BIOL 208 (Principles of Ecology) and BIOL 433 (Plant-animal Interactions) in 2004/05.

Dr. Mark Lewis (CRC Mathematical Ecology) teaches the graduate level course BIOL 570 (Models in Ecology) in which a few undergraduates have also enrolled in the past.

Dr. Sally Leys (CRC Evolutionary & Developmental Biology) teaches half of BIOL 361 (Marine Science) and half of ZOOL 303 (Animal Developmental Biology); these have enrolments of 184 and 39, respectively. She will also participate in teaching the new course BIOL 495 in 2004/05.

Dr. Andrew Waskiewicz (CRC Genetics of Vertebrate Development) contributed to the teaching of ZOOL 303 (Animal Developmental Biology) last year. In addition to this, he will contribute to part of ZOOL 402 (Current Topics in Developmental Biology) and develop a new 400 level course in Animal Development Genetics in 2004/05.

AHFMR Scientists/Scholars:

Dr. Linda Reha-Krantz teaches GENET 408 (enrolment 43).

Dr. Kathy Magor teaches parts of IMIN 200 (Infection and Immunity), 372 (Research Techniques in Immunology) and 401 (Comparative Immunology) with enrolments of 233, 23 and 17, respectively.

Dr. Tracy Raivio teaches one section of GENET 270 (Foundations of Molecular Genetics; enrolment 153) and parts of GENET 304 (Gene Expression and its Regulation; enrolment 98).

Alberta Ingenuity Scholar: Dr. David Coltman (AI Scholar Molecular Ecology) joining the Department in July 2004. He will be involved in teaching BIOL 380 (Genetic Analysis of Populations).

Department of Chemistry

The three Chair holders teach one course/year. The courses taught by these individuals will vary from year to year as needed, but the following was their teaching component last year.

Strathcona County Lemieux Chair in Carbohydrate Chemistry: Dave Bundle – Organic Chemistry II. Chemistry 263 (enrolment 53)

Canada Research Chair: John Vederas – Organic Chemistry I. Chemistry 161 (enrolment 205)

Canada Research Chair: Rod Wasylishen – Applications of Nuclear Magnetic Resonance Chemistry 483 (enrolment 9)

Department of Computing Science

Canada Research Chair: Schuurmans (Tier II/ teaching load = .66 or 2 single semester courses per year): CMPUT 366 (AI), CMPUT 466 (machine learning).

Canada Research Chair & iCORE Chair: Schaeffer(Tier I, iCORE/teaching load = .5 or 1-2-1-2-1 across 5 years): CMPUT 201 (programming methodologies), CMPUT 415 (compiler design)

iCORE: Sutton (teaching load = .5): none yet

iCORE: Zhang (teaching load = .5): CMPUT 412 (experimental mobile robotics),CMPUT 229 (machine architecture)

V. Summer Research:

Department of Biological Sciences

Over 50 summer students supported by NSERC Summer Studentships and/or AHFMR Summer Studentships perform field and bench research in over 30 laboratories yearly

Numerous research grant and contract supported summer research opportunities are also available annually

STEP and SCP programs places students in summer research positions

WISEST program places female senior high school students in labs often resulting in students following up on research path upon entering university

Department of Chemistry

Each year has 50 - 60 undergraduate involved in summer research projects, of which approximately 30/year are supported by NSERC, AHFMR, Pfizer, or ACB scholarships. In addition, 1 - 2 students participate in the summer RISE program (see above) and 0 - 3 students participate in summer research at other universities through other programs. Also, 2 - 5 students are involved in research during the academic term in the Department not affiliated with any course.

Department of Computing Science

During summer 2002, 35 undergraduate students were employed as summer research assistants (14 held NSERC undergraduate summer scholarships, the remainder were supported entirely by faculty research grants). During summer 2003, 50 undergraduate students were employed as summer research assistants (12 NSERC, 2 employed as IIP students by the Department, and the remainder funded fully by faculty research grants).

VI. Recent Initiatives:

Department of Biological Sciences

BioDITRL

A collection of visual aid materials available for use in teaching by other institutions and by the Edmonton Public School
Teaching and research materials and related images and animations
All materials submitted are refereed
Community outreach as well as teaching aid

DITRL

Facility and personnel to develop digital and electronic teaching and research presentation materials
Also a collection of images and materials for several courses offered by the department (e.g., parasitology course)
Industrial Internships for DITRL/BioDITRL
Placement of undergraduate student as part of the IIP program in Science
At least one student per year placed
Involved in developing on-line teaching materials such as animations

Molecular Biology and Microscopy Service Units

Students working on honors' thesis and summer research projects extensively use these advanced laboratories

Research Posters and Displays

Our department has numerous examples of research posters and exhibits, which are intentionally placed near undergraduate classrooms so that students will be exposed to the many career options and interest areas in biology.

Ongoing Summer Student Research Initiatives

Over 50 summer students supported by NSERC Summer Studentships and/or AHFMR Summer Studentships perform field and bench research in over 30 laboratories yearly

Numerous research grant and contract supported summer research opportunities are also available annually

STEP and SCP programs places students in summer research positions

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Department of Chemistry

The entire chemistry program is currently being examined in detail and numerous changes are being made to enhance the undergraduate's experiential learning and scholarly inquiry. Just a few examples are given below.

A. Experiential Components. Most, if not all, research shows that students are engaged more and do better when allowed to do hands-on work, the earlier the better. Chemistry has committed to requiring and experiential component to our Honours program, either Chem400 or Chem401, by Fall, 2005. In addition, we are adding Chem299 a research opportunity for second-year students in Honours and Specialization Chemistry as an option by Fall, 2005.

B. Better hands-on opportunities. Chemistry, more than any other discipline, requires a solid grounding in modern techniques of analysis. Because techniques are only now becoming available to directly observe molecules, most established analytical techniques are indirect and, therefore, expensive. The high cost of lab equipment for chemistry, combined with the almost total lack of funding agencies for teaching offers a significant challenge in providing students the modern, hands-on experience they require as part of their education. Chemistry has had one success in finding a suitable solution for an NMR instrument for our undergraduate labs, arguably one of the most important characterization techniques in chemistry. We hope to have a state-of-the-art 400 MHz instrument in our labs by Fall, 2004, funded by the Faculty of Science, Department of Chemistry, and an anonymous Chemistry donor. Nevertheless, this issue will occupy the Department over the next few years as we strive to improve and modernize the hand-on experience our undergraduates receive in Chemistry courses

Department of Computing Science

Our main efforts are directed in ensuring our undergraduate teaching labs at all levels reflect state-of-the art hardware and software.

New courses and labs are always under development, under the direction of our faculty (current examples: computer vision course to be test-run next year; a new robotics course to be test-run next year). It's fair to say that new course

development at this level and of this character is driven by the fact that we are a research-intensive faculty.

Every five years, we undergo an external accreditation process by an independent review board, the Canadian Information Processing Society, which has published standards for university computing science curricula. We also evaluate our curriculum against ACM/IEEE standards, which are revised every five years. These efforts directly impact the continued development of our undergraduate programs.

The bioinformatics degree programs that both Departments of Computing Science and Biological Sciences offer are specialized undergraduate programs of study that very directly reflect the research strengths of our bioinformatics faculty.

Department of Computing Science

Field Schools

A critical part of several of our programs is the field-based component, as exemplified by the five field schools we run every year. We have integrated modern techniques, such as GPS receivers, data loggers, and computer-based mapping tools, to ensure our students are exposed to current and cutting-edge methods in field studies. For example, we have developed a close working relationship with Campbell Scientific, a leading designer and manufacturer of data loggers and associated instrumentation. They provide both equipment and technical expertise to our Environmental Earth Sciences field school every year.

To provide additional field experience for our students, we have recently added a fourth-year field course, which is run in collaboration with the C.S. Lord Geoscience Centre in Yellowknife, N.W.T. in late August. This course has very limited enrollment, because of the logistics involved in the fly-in camp that it uses as a base in the N.W.T. north of Yellowknife. We handpick the six best field geologists, based on their performance in the required second- and third-year field schools (EAS 234 and 333, respectively), for this opportunity. They spend two weeks in the field with two faculty members from the Department and a number of professional geologists from the C.S. Lord Geoscience Centre. They map in an area previously unmapped, and ultimately produce a geological map for that area. This field school ran for the first time in August 2003 with five students (the sixth had to withdraw at the last minute because of an injury); the students and faculty involved subsequently gave presentations at the Yellowknife Geoscience Forum in November 2003. Three of the students worked on projects derived from this field school for their Undergraduate Theses; another had already formulated her thesis project based on the work she did during that summer for the Alberta Geological Survey. The students gave presentations on their research at the WIUGC in Vancouver in January 2004 (see above).

These field schools are an essential component of our undergraduate students' education, but they are expensive to run. In particular, the N.W.T. field school is very expensive; we have been very fortunate in that the C.S. Lord Geoscience Centre had obtained H.D.R.C. funding for this field school for 2003 and 2004, but we will need to obtain alternative funding for subsequent years to continue this innovative and unique opportunity for our students. We have worked to find non-University funding to help fund these field schools. For example, working with the Faculty of Science Development Office, our Chair has been successful in obtaining donations from alumni that are directed towards the costs of our first and second-year field schools.

Addendum:
Examples of subsequent success of industrial internships, honors thesis, and summer research students, Department of Biological Sciences

Research experience contributes to the success of undergraduate students in terms of scholarships competitions and admission into graduate programs.

NSERC PGSB (PGSD) SCHOLARSHIP RECOMMENDATIONS				
(Biological Sciences BSc Graduates)				
	For Academic Year			
	2002-2003	2003-2004	2004-2005 (PGSD or CGSD)	Totals
Number of PGSB (now PGSD) Recommendations	12	12	18	42
Had research experience	12	12	18	42
Completed an honors thesis	9	11	16	36
Had summer research experience	9	11	16	36
Had both honors thesis and summer research experience	7	10	15	32
Received the NSERC PGSB (D) Scholarship	9	11	12(to date)	32

NSERC PGSA (PGSM) SCHOLARSHIP RECOMMENDATIONS				
(Biological Sciences BSc Graduates)				
	For Academic Year			
	2002-2003	2003-2004	2004-2005 (PGSM or CGSM)	Totals
Number of PGSA (now PGSM) Recommendations	18	13	17	48
Had research experience	18	13	17	48
Completed an honors thesis	10	11	11	32
Had summer research experience	7	13	17	37
Had both honors thesis and summer research experience	10	11	11	32
Received the NSERC PGSA (M) Scholarship	16	11	11	38

RESEARCH EXPERIENCE FOR GRADUATE STUDENTS ADMITTED IN PAST 3 YEARS			
	For Academic Year		
	2002-2003	2003-2004	2004-2005 (as of April 27, 2004)
Total Admitted	63	72	24
Had research experience	51	53	20
Completed an honors thesis	32	37	15
Had summer research experience	28	30	16
Had both an honors thesis and summer research experience	20	21	11

Department of Earth and Atmospheric Sciences
The Undergraduate Research Experience:
Snapshot May 2004

Introduction

The Department of Earth and Atmospheric Sciences has 42 academic staff, of whom 39 are tenure-track teaching faculty, ~120 graduate students, and 250 undergraduate students registered in our degree programs. Of the undergraduate students, twenty-seven are in the B.Sc. Specialization or Honors program in Atmospheric Sciences, twenty-one are in the B.Sc. Specialization or Honors program in Environmental Earth Sciences, ninety-five are in the B.Sc. Specialization or Honors program in Geology, and eighteen are in the B.Sc. Honors program in Paleontology. An additional sixty-seven are B.S. Majors in Earth and Atmospheric Science, and twenty-two are B.A. Majors in Human Geography. In total, we currently have 35 students in Honors programs, 126 in Specialization, and the remainer in a Major program. We do not track students who have declared a minor in either Earth and Atmospheric Sciences (B.Sc.) or Human Geography (B.A.).

The faculty of the Department of Earth and Atmospheric Sciences are researchers of national and international stature, who weave their research experiences and background into their teaching whenever possible. The foundation knowledge necessary for research in the various subdisciplines in EAS is typically sufficiently broad in scope that it is unusual for students to be an active, contributing participant in formulating and conducting research projects until their third or fourth year. This reflects the intrinsically interdisciplinary nature of our sciences. A notable exception is our field courses, in which the students undertake, on a limited scale, the same type of field study that is integral to research at the postgraduate level by both academic and professional practitioners.

In other subdisciplines, once the students have the requisite knowledge base, they are active in research, both in individual classes and for undergraduate theses and directed study projects. Over the past five years, 70% of our B.Sc. Honors and Specialization students have completed Honors Theses or Directed Study projects. Many of these projects are outgrowths of summer research opportunities, either in the Department, in industry, or in Federal, Provincial, or Territorial government agencies.

Courses

In all our programs, the majority of our fourth-year undergraduate courses involve research, typically in the form of a project that includes a class presentation and a paper on the results of the research (see Appendix 1). Depending on the subject of the course, the type of research involved ranges from strictly library-based reading of primary literature and synthesizing that information, to projects that involve laboratory-based or field-based measurements that are integrated into the body of information on a given topic.

In addition to the research exposure in these courses, our fourth-year Honors students must enroll in EAS 426 (Honors Thesis1). Students in Specialization programs may enroll in EAS427/428 (Directed Study). Both of these courses allow them to work closely

with a faculty member on a research project that typically spans a full academic year. In most cases, the end result of an EAS 427/428 is a thesis of comparable quality to those produced from EAS 426. Many of the projects that form the basis of both the 426 and 427/428 courses are outgrowths of research conducted by the student in the summer following their third year in the program. This summer research includes that funded by NSERC USRAs, industry, and Federal and Provincial government agencies. In the latter two situations, the industry or government project is developed and expanded under the guidance and supervision of a faculty member in the Department. Often the agency involved will contribute funds toward analytical or other research costs.

Almost every one of the undergraduate research projects conducted in the Department take advantage of equipment and facilities that are present in the Department only because of the externally-funded research of faculty members; such facilities include the scanning electron microscope, the electron microprobe, the new LA-ICPMS (laserablation inductively coupled plasma mass spectrometer), the thermal ionization and gas source mass spectrometers, the micro-focusing FTIR (fourier transform infrared) spectrometer, the experimental facilities in the C.M. Scarfe Laboratory for Experimental Petrology and the new Laboratory for Comparative Planetology, and the GIS/Remote Sensing computers, image libraries, and reflectance spectrometers of the EOSL (Earth Observation Systems Laboratory.

Both the formal thesis course (EAS 426) and the Directed Study courses (EAS 427 and 428) are popular with our students; over the past five years, we have averaged 12 theses and 23 Directed Studies per year. To place these numbers in context, over the same time period, we averaged 50 graduates per year from our Specialization and Honors programs, so on average 70% of our students take advantage of our research-based 426 and 427/428 courses.

Our Human Geography program successfully incorporates research papers and projects into some of their second- and third-year courses, as well as their fourth-year courses (see Appendix 1). This may result from the relatively small cohort of students in that area, and perhaps as well a difference in philosophy between the Faculty of Arts-based Human Geography program, and our other programs based in the Faculty of Science. Recent additions to our program in Human Geography are the Directed Study courses (EAS 497 and 498), which were introduced in 2000-01. Since that time, ten students have enrolled in these courses. This relatively low number may result from the small number of students majoring in Human Geography (averaging five graduates/year), or may reflect the high proportion of courses in the Human Geography program that have an integrated research component.

Public Forums/Events

Although the Department currently has no Departmental fora for undergraduate students to discuss their research, we are considering introducing an Undergraduate 1 As of 2004-05, EAS 426 has been renamed ‘Undergraduate Thesis’ and is available to both Specialization and Honors students. It remains a required course for our Honors programs, but is an option for Specialization students. Research Symposium to be held in

the latter part of second term for students to present the results of their Undergraduate Theses and Directed Study projects. Undergraduates in the geology program do participate in the WIUGC (Western Inter University Geological Conference), which is held every January. Both undergraduates and graduate students present research talks and posters at this event. At the 2004 WIUGC in Vancouver, undergraduate students from our Department won awards for the Best Undergraduate Talk and Best Undergraduate Poster. Other recent venues at which our undergraduate students have presented include the GAC-MAC (Geological Association of Canada – Mineralogical Association of Canada) Annual Meetings in 2003 and 2004, the Yellowknife Geoscience Forum in 2003, the 2004 Spring Meeting of the AGU (American Geophysical Union), the Eighth International Kimberlite Conference in 2003, and the 2004 Annual General Meeting of the Western Division, Canadian Association of Geographers.

Some undergraduate projects result in publication in peer-reviewed journals. For example, Steven Creighton's undergraduate research led to a publication in the Proceedings of the Eighth International Kimberlite Conference, which is to be published in the peer-reviewed journal Lithos. Another example is the combined undergraduate research projects of Melissa Bowerman and Amy Bablitz; one paper has been accepted by a peer-reviewed journal (The Canadian Mineralogist), and two others are in preparation for submission.

Undergraduate Teaching

We have a number of endowed Chairs within our Department, including a Vargo Teaching Chair, the C.R. Stelck Chair in Petroleum Geology, a Northern Research Chair, a CIAR Fellow, and three Canada Research Chairs. For the Research Chairs, it has been Departmental policy to release the Chair from one course's teaching duties, so they teach two courses per year rather than the Department norm of three courses. Their current or most recent teaching responsibilities are outlined below.

- Tom Chacko, the Vargo Teaching Chair, is very active in undergraduate teaching; in 2003-04 he taught EAS 332 (Metamorphic Petrology), a required third-year course for our Geology program students, half of the fourth-year EAS 436 (Advanced Igneous and Metamorphic Petrology), as well as half of a graduate seminar. In addition, he co-led our NWT field school (see ***Recent Initiatives*** below).
- Brian Jones, the C.R. Stelck Chair in Petroleum Geology, is Chair of the Department and has no current undergraduate teaching duties. He previously taught a variety of courses at the undergraduate level, including Sedimentology, Sedimentary Petrology, Introductory Earth Sciences, and Field School.
- John England, the Northern Research Chair, was on sabbatical in 2003-04, but cotaught EAS 110 (First Year Field School) and a graduate course in 2002-03, and is scheduled to teach the fourth-year EAS 451 (Arctic Environments) course in 2004-05, in addition to a graduate course.
- Andrew Bush, CIAR Fellow, taught two undergraduate courses in 2003-04, EAS 370 (Applied Atmospheric Physics) and 373 (The Climate System). Both of these courses are core courses in our Atmospheric Sciences program.

- In 2003-04, Senior Canada Research Chair George Pemberton taught EAS 330 (Stratigraphy), which is a required third-year course in our Geology program, in addition to a graduate course.
- Canada Research Chair Kurt Konhauser taught EAS 205 (Environment Earth), a second-year course designed for non-majors, in 2003-04. He also taught a graduate course in Geomicrobiology.
- Canada Research Chair Thomas Stachel has taught EAS 232 (Mineralogy II), a core second-year course in our Geology program, for three years now. He also teaches a graduate course.

Research Opportunities: Summer and Term

The Department of Earth and Atmospheric Sciences is an active participant in the NSERC USRA program. Over the past five years, twenty-three (out of 42) faculty have participated in this program; some have supervised as many as seven USRA students over that time. Many of these students continue on into graduate school (see table below).

NSERC Undergraduate Student Research Awards

Year	*Student*	*Supervisor*
2004	Michelle Blade	Peter Kershaw
	Robyn Ferguson	Brian Chatterton
	Sarah Gammie	Robert Luth
	Shoshana Goldstein	Robert Luth
	Anita Gue	Carl Mendoza
	Cristen Krauss	Thomas Chacko
	Thomas Lakeman	John England
	Wendy Markowski	Peter Kershaw
	Jessica Norris	Christopher Herd
	Edward Pollock	Andrew Bush
	Kathleen Smart	Thomas Chacko
	Matthew Vavrek	Brian Chatterton
	Brett Wheler	Paul Myers
2003	Steven Creighton*	Thomas Stachel
	Erin Doxsey-Whitfield	John Shaw
	Shoshana Goldstein	Paul Myers
	Natalie Hayes*	Michael Caldwell
	Lesley Hill*	Edward Lozowski
	Thomas Lakeman**	John England
	Jessica Liggett	Carl Mendoza
	Ryan McKellar*	Brian Chatterton
	Lynn Reich*	George Pemberton
	Adrienne Thompson	John England
	Marilyn Zorn*	George Pemberton
2002	Melissa Bowerman*	Robert Luth
	April Fenwick	George Pemberton
	Shoshana Goldstein	Paul Myers
	Natalie Hayes*	Brian Chatterton
	Ryan Ickert*	Octavian Catuneanu
	Patrick Nicoll*	Robert Luth
	Lynn Reich*	Octavian Catuneanu
	Adam Sanderman	George Pemberton
	Michelle Trommelen*	John England
	Matthew Vavrek	Michael Caldwell

Katie von Gaza	John England
Christopher Wielki	Andrew Bush

*Students now in graduate studies.
**Students accepted for graduate studies in Fall 2004.

In addition to the students involved in the USRA program, other undergraduate students are involved in research during the summer as research assistants, both in the lab and in the field. From 2002 to 2004, twenty-two faculty in the Department have employed twenty-eight undergraduate students as research or field assistants, exclusive of those in the USRA program. Some of these positions are during the summer, but a number of these Research Assistants are employed during the academic year on a part-time basis as well.

Our faculty conduct field studies in diverse areas; including the high Arctic, the Caribbean, and Central and South America. Most of these field studies require field assistants, and our undergraduate students, because of their background, are the prime candidates for these jobs. In addition to valuable field experience, the undergraduate student usually builds a strong rapport with his or her graduate student or faculty supervisor, which leads to an informal mentoring situation and often to increased interest on the part of the undergraduate student to continue on in research, both at the undergraduate level, enrolling in EAS 426, 427, or 428, and into graduate studies.

Many of our undergraduate students work during the summer in their field of interest. As mentioned above, these students will often return for their fourth year with a proposed project based on their work during the summer, which they use as the basis for a thesis or directed study project during their fourth year. Recent examples of this include students whose summer employment was with the oil and gas industry, the Alberta Geological Survey, DIAND, and mineral exploration firms.

Another route for our students to do research is through the Industrial Internship Program, of which the Department is an active participant. Some employers set up their internships such that an independent research project, mentored and advised by one of their people, is an integral part of the student's IIP placement. Environment Canada, which has employed up to three of our Atmospheric Sciences B.Sc. students every year for the past four, is particularly proactive in this regard. The research project the student works on while at Environment Canada is clearly a high point of their IIP experience, and is typically the centerpiece of the oral presentation that the student gives upon return to the Department.

Recent Initiatives to Enhance the Undergraduate Learning Environment

Field Schools
A critical part of several of our programs is the field-based component, as exemplified by the five field schools we run every year. We have integrated modern techniques, such as GPS receivers, data loggers, and computer-based mapping tools, to ensure our students

are exposed to current and cutting-edge methods in field studies. For example, we have developed a close working relationship with Campbell Scientific, a leading designer and manufacturer of data loggers and associated instrumentation. They provide both equipment and technical expertise to our Environmental Earth Sciences field school every year.

To provide additional field experience for our students, we have recently added a fourth-year field course, which is run in collaboration with the C.S. Lord Geoscience Centre in Yellowknife, N.W.T. in late August. This course has very limited enrollment, because of the logistics involved in the fly-in camp that it uses as a base in the N.W.T. north of Yellowknife. We handpick the six best field geologists, based on their performance in the required second- and third-year field schools (EAS 234 and 333, respectively), for this opportunity. They spend two weeks in the field with two faculty members from the Department and a number of professional geologists from the C.S. Lord Geoscience Centre. They map in an area previously unmapped, and ultimately produce a geological map for that area. This field school ran for the first time in August 2003 with five students (the sixth had to withdraw at the last minute because of an injury); the students and faculty involved subsequently gave presentations at the Yellowknife Geoscience Forum in November 2003. Three of the students worked on projects derived from this field school for their Undergraduate Theses; another had already formulated her thesis project based on the work she did during that summer for the Alberta Geological Survey. The students gave presentations on their research at the WIUGC in Vancouver in January 2004 (see above).

These field schools are an essential component of our undergraduate students' education, but they are expensive to run. In particular, the N.W.T. field school is very expensive; we have been very fortunate in that the C.S. Lord Geoscience Centre had obtained H.D.R.C. funding for this field school for 2003 and 2004, but we will need to obtain alternative funding for subsequent years to continue this innovative and unique opportunity for our students. We have worked to find non-University funding to help fund these field schools. For example, working with the Faculty of Science Development Office, our Chair has been successful in obtaining donations from alumni that are directed towards the costs of our first and second-year field schools.

Computer Applications in EAS

Several areas of our varied disciplines use specialized computer software extensively. Examples of these that are relevant to our undergraduate programs are the areas of GIS (Geographical Information Systems/Science), hydrogeology, and structural and petroleum geology. All three of these areas require dedicated computer labs with sufficient computational resources to run industry-standard software (e.g., ARCVIEW, ARCGIS for GIS). We have two dedicated computer labs (ESB 1-39, Tory 2-87) to support these, and other courses that require computer exercises in their labs. Our IT support staff includes a GIS specialist (Valery Companiytsev) in addition to workstation and network analysts. Unfortunately, these labs are currently oversubscribed, and we are unable to accommodate requests from instructors in other courses that wish to schedule

time in the computer labs. Additional computer lab space will become available in the CCIS when it is completed.

We have successfully involved industry in our efforts to ensure that our students are trained on industry-standard software (e.g., Accumap and IDC, in addition to those mentioned above). This software is used both by academic researchers at our and other universities, and by professionals working in a variety of industries. Many of the companies have donated software or have provided site licenses at significant discounts for our student laboratories.

Appendix 1.

Courses in the Department of Earth and Atmospheric Sciences with a research component:

Faculty of Arts (Human Geography):

EAS 293 The Urban Environment
EAS 391 Introduction to Environmental Planning
EAS 392 Research Methods in Human Geography
EAS 394 Issues In Human Geography
EAS 395 Health, Space and Place
EAS 491 Resource Management and Environmental Policy
EAS 492 Geographical Information Systems for Social Science
EAS 493 Human Dimensions of Global Change
EAS 494 Environment and Health
EAS 497 Directed Study in Human Geography I
EAS 498 Directed Study in Human Geography II

Faculty of Science (Atmospheric Sciences, Environmental Earth Sciences, Geology, and Paleontology programs):

EAS 225 Earth Surface Processes and Landforms
EAS 234 Geology Field School
EAS 250 Biogeography
EAS 333 Advanced Geology Field School
EAS 354 Environmental Earth Sciences Field School
EAS 420 Geochemistry II
EAS 421 Advanced Structural Geology
EAS 422 Basin Analysis
EAS 424 Subsurface Geological Methods
EAS 426 Undergraduate Thesis
EAS 427 Directed Study I
EAS 428 Directed Study II
EAS 430 Petroleum Geology
EAS 432 Precambrian Geology
EAS 434 Geochemistry of Ore Deposits
EAS 435 Geotectonics
EAS 436 Petrogenesis of Igneous and Metamorphic Rocks
EAS 437 Geology of Canada
EAS 451 Digital Remote Sensing
EAS 453 Arctic Environments
EAS 455 Alpine Environments
EAS 457 Global Change
EAS 470 Clouds and Storms
EAS 471 Atmospheric Modelling
PALEO 414 Paleontology

Department of Mathematical and Statistical Sciences

Undergraduate Research Experience
June 2004

Introduction

The faculty in the Department of Mathematical and Statistical Sciences are researchers of national and international stature. Each year several faculty members hire some of our strongest undergraduate students as research assistants. The background knowledge required for research in the various branches of mathematics is sufficiently broad that it is unusual for an undergraduate student to produce original results. Traditionally, our undergraduates are prepared for mathematical and statistical research through our honors programs. These programs consist of sequences of specialized courses that are designed to provide a broad understanding of the corresponding discipline, to teach abstract reasoning and the skills required for exposition.

Courses

All of our honors students are required to take Math 496 in either their third or fourth year. It is in this course that they are introduced to some of the recent research in mathematics. For the most part, the emphasis of the course is to give each student an opportunity to investigate recent work in an area of his/her choosing. Each student prepares a project on some aspect of a particular area of research. At the end of the term each student gives a presentation to the class on the material he/she has read. This has proven to be an excellent preparation for students who intend to go no to graduate work in mathematics or statistics. Our department chair, Dr. Tony Lau, was telling me recently that 3 of the 7 students in the Math 496 class that he taught a few years ago have gone to complete PhDs in the area in which they did their project. It was also announced this recently that one of these students has been named the winner of the 2004 Canadian Mathematical Society's Doctorial Prize. To give the students the attention they need, our Math 496 classes are usually very small. For example, there were two classes of Math 496 with 7 students each the year referred to above. Usually a large percentage of the students who complete one of our honors degrees go on to do graduate work.

Students who take statistics course can get an introduction to research methods as early as their second year. Dr. Kolacz has setup a web site with several case studies for Stat 252 that focus on the statistical methods used in specific published research papers. These studies are broken into several parts to illustrate the steps involved in a statistical study. This method is carried forward to the laboratory projects in Statistics 252 where students are given data and background information for several statistical studies and are then required to analyze the data and make recommendations based on that analysis. They are also questioned about the appropriateness of the design and statistical methods used in the studies.

In Stat 475 students are asked to complete a project that accounts for 20% of their final grade. For this project, each student has to find an appropriate data set, determine a method for analyzing the data and prepare a report on his/her findings. Each student is required to present his/her project to the class. Examples of the best projects are published on the course web site.

Research Opportunities: Summer and Term Projects

Every year a number of senior undergraduate students are employed to assist faculty members with research projects. Many of these students are funded through the NSERC USRA program. The table below list the NSERC Undergraduate Student Research Awards held by undergraduates in this department during the summers of 2003 and 2004.

Year	Student	Supervisor
2003	Cheng, Carson KS	George Peschke
	Dagenais, Genevieve E	Michael Li
	Hammerlindl, Andrew S	John Bowman
	Khussheed, Fareeza	Sam Shen
	Kublik, Richard A	Gerda De Vries
	Macdonald, Jeremy	Terry Gannon
	McIntyre, Laura A	Michael Li
	Nault, Joshua T	Bruce Sutherland
	Semenjuk, Steven R	Sam Shen
	Stewart, Liam H	Michael Kouritzin
	Van Weelden, Richard M	Michael Kouritzin
	Wasylishen, Stephen J	Bin Han
	Yewchuk, Kerianne P	Bruce Sutherland
2004	Ashburner, Michelle RM	Maziar Shirvani
	Barrigton-Leigh, Robert RM	Gerda de Vries
	Khurshed, Fareeza	Sam Shen
	Macdonald Jeremy	Terry Gannon
	McIntyre, Laura A	Sam Shen
	Nault, Joshua T	Bruce Sutherland
	Neitsch, Andrew D	James Muldowney
	Newton, Fraser E	Michael Kouritzin
	Ondrus, Alexander A	Gerald Cliff
	Van Weelden, Richard M	Michael Kouritzin
	Vogt, Ryan A	Mazizr Shirvani

In addition to the opportunity provided by the NSERC USRA program, many of the above students also worked with the indicated supervisor as research assistants during the fall and winter term and were funded by their supervisors' research grants.

The following students who did not receive NSERC USRA were funded by their supervisors' research grants during the 2003-04 academic year. These students are also assisting the indicated supervisor with research projects during the summer of 2004.

Year	Student	Supervisor
2003-04	Beltaos, Andrew	Gerda De Vries & Mark Lewis
	Blackburn, Patrick	Bruce Sutherland
	Cochrane, Andrea	Bruce Sutherland
	Griffin, Spencer	Hans Kunzle
	Hammerlindl, Andrew	John Bowman
	Kyba, Patrick	Bruce Sutherland\
	Prince, Thomas	John Bowman
	Steinberg, David	James Lewis

Some of the research projects the students are assisting with include the following: the design and development of a high-level mathematically oriented graphing interface to the postscript vector graphics language; creating a dataset for the Alberta drought history based on historical documents and using this dataset to assess climate changes in Alberta; determining a mathematical formulation of the optimal surface temperature from weather station data; modeling the effects of radiotherapy in treating ovarian cancer; the preparation of materials for the department's mathematical biology summer school; generating a model of the flight path of a spinning spherical object in the atmosphere (application: golf, tennis and baseball) and modeling the dispersal of pollutants from flares. Several of the students have given talks at conferences and workshops on their work. At least 6 of the undergraduate students named above are co-authors on papers recently submitted for publication by their supervisors.

Enhancing the Undergraduate Learning Environment

Over the last few years, members of the Department of Mathematical and Statistical Sciences have undertaken a number of initiatives to enhance the learning environment of our undergraduate students. Here are a few examples. The labs in many of our first and second year mathematics and statistics courses have been revised and now make substantially usage of the visualization and analysis available in modern computer programs. In addition, many of our statistics labs now use actual experimental data so that laboratory assignments mimic real statistical studies. Many of our faculty members have extensive web sites for their courses. These web sites typically contain lecture notes, assignments, assignment solutions, sample exams with answers and students' grades to date. Also a number of instructors have developed elaborate Powerpoint materials with extensive graphic and animation that they use to enhance their lectures. In 2004-05 the department will be offering an internet course for the first time. The materials for that course was designed and developed by Gr. George Peschke with funding from a several sources. Dr. Henryk Kolacz was recently awarded $94,000 by the Albert government under its access program to develop a program that will enable students to complete and submit their laboratory assignments from home. We have hired an Industrial Internship student for each of the past 5 years to assist instructors with the development of web materials for their courses and help them maintain a web site for each of their courses.

Endowed Research Chairs

The department has three Canada Research Chairs. It has been department policy to release Research Chairs from one half of the normal teaching duties of a continuing faculty member. As a result, Research Chairs normally teach three courses in two years. In 2003-04, the department's Research Chairs taught 2 introductory undergraduate courses and 3 graduate courses.

Enhancement of Undergraduate Experience: Physics Department

Department of Physics provides undergraduate students with a flavor of research experience in several ways: (i) encouraging the faculty to use their own research as examples in undergraduate courses; (ii) offering project courses specifically designed to give undergraduates an opportunity to conduct an "independent" research; (iii) involve undergraduate students in research during summers and/or through the academic year; (iv) requesting fourth year students to attend weekly departmental colloquia throughout the year; (v) encouraging senior undergraduate students to attend seminars organized by one of four research focus areas in the Department. Below, more detailed information is given concerning each of the points.

- Although it is rather difficult to incorporate modern research results into junior physics or geophysics courses in any prescribed manner some instructors seem to find a way of exposing students in a classroom to research, either their own or by other members of the Department. The course outlines do not formally require doing this and the situation is different in each course and between different sections of the same course.

  The examples below do not pretend to give the complete picture:

  An in–home research is introduced in a very general way in Phys 114 – a largely qualitative course aimed at students in Arts in which the overall structure and main concepts of physics are examined. For example, the introduction of time and its units is accompanied by the discussion of the shortest accessible time intervals. The pump–probe experimental set up, used in several labs in our Department, is described and accompanied by demonstrations (e.g. an impressive demo of a fan and a strobe light). Discussion of the shortest distances is accompanied by "photographs" of atoms taken in our labs using modern imaging techniques like Transmission Electron Microscopy (TEM) or Scanning Tunneling Microscopy (STM).

  In Phys 126 – the algebra based introductory physics course (attended mainly by life sciences students) one of the instructors discusses examples from her own research on applications of mass spectroscopy to isotopic and trace–element analysis of geologic material and from her involvement in sending a mass spectrometer to do the first in–situ analysis of comet dust particles. Also, current research at the University on the generation of Earth's magnetic field is described. Reversal of the Earth's magnetic field never fails to fascinate students in this course. In other section of the course, elements of the instructor's own research at TRIUMF are incorporated when the appropriate topics come up, real life examples of e.g. velocity selectors (with crossed electric and magnetic fields), magnetic moments, solenoids, etc. are described.

  One of the instructors in Phys 130 – the introductory physics course for engineering students – attempts to show the students that the material which they learn is not a "dead old physics" but that there are research developments that are both interesting

and practical in the areas of physics taught at a junior level. The examples are taken from sources like:
American Institute of PhysicsWeekly Bulletin (materials with negative refractive index, slowing down and stopping light); Physical Review Focus (use of photonic crystals, photon splitting); Discover/Scientific American (shock waves in astrophysical objects, polarized light in astronomy); and other miscellaneous sources (seismic waves, adaptive optics, Keck telescope, light guide and Doppler effect applications in medicine. The instructor plans to incorporate these items into the WebCT pages for the course (once the copyright issues are resolved). Teaching physics to engineering students at a junior level is a challenge. Majority of students find such "extras" interesting and valuable but there is always a margin of about 10% students who prefer to be taught a bare minimum without "complicating" the course.

In Astro 120 one of the instructors describes her own research on meteorites, asteroids, and early solar processes.

Discussion on the Standard Model of Elementary Particles in Phys 200 (Relativistic aspects of modern physics – a course for non physics students) and in Phys 351 (Relativity – one of the core physics courses) generates usually a lot of excitement when muon decay experiments confirming relativistic time dilation are described. When relativistic energy relations are discussed the instructor tells the students how Dirac got his famous equation by incorporating these relations into quantum mechanics and then introduces the students to his own research in which the Dirac's equation is used to study atomic nuclei. The students use examples from his research to find the threshold energies in the photo-production of _–mesons. The search for Higgs bosons – the research direction at the forefront of high energy physics in which our colleagues are involved – and the energies needed in this search are also discussed.

In the introductory computational physics course, Phys 234, the need to solve sets on non linear equations for large systems is illustrated by showing original results from a finite element simulation of the magnetosphere. The instructor distributes 3D stereo glasses to show a 3D mesh used in the simulations.

In the course on electron microscopy, Phys 319, the instructor's own research data are integrated into the course.

In the environmental physics course, Phys 364, the instructor spends extra time to discuss her own experience with stratospheric aerosols and with collection of interplanetary and terrestrial (of volcanic origin) dust particles in the stratosphere. This allows to illustrate the physical behavior of particulate matter in the atmosphere – one of the important topics in the course.

In the introductory space and atmospheric physics course Phys 429 the students are introduced to the ground–based research, to the rocket and spacecraft instrumentation, and to computational modeling in which Canadian space scientists, including the

instructor, are involved. In order to help students to visualize the interaction between the solar wind and the Earth's magnetosphere the instructor's own magnetohydrodynamical simulations are presented and discussed.

In the senior condensed matter physics course, Phys 417, the instructor's own experimental research data on superconductivity, done at TRIUMF, are used.

In geophysics Geoph 332, 424, 438 the field data collected for research are used in class or as part of the research projects.

- The Department offers presently three undergraduate courses that give students opportunity to research an independent research guided by one or more faculty members. These are: Phys 491 (Advanced Laboratory), Phys 493 (Instrumentation B), and Phys 499 (Special Projects). In order to consolidate the offering, the Department will no longer offer the first two courses but will offer Phys 499 in each term and allow students to take it more than once provided the student works on different research topic each time (preferably under different supervisor). The projects in Phys 499 can be selected from all areas of physics, astrophysics, geophysics, and medical physics. Each student willing to register in Phys 499 is expected to get familiar with the research directions in the Department, contact a prospective supervisor and have the project defined. The coordinators of the course (usually both associate undergraduate and graduate chairs) solicit projects from the Physics faculty but usually the students do a quite good job finding the project and the supervisor independently. Occasionally, the supervisors are selected from the Departments of Mathematics, or Chemistry. The course formally starts with an organizational meeting in the first week of classes. During the term the students conduct independent experimental or theoretical investigations. There are no formal rules concerning the frequency and the form of the student – supervisor interactions. Around the midterm week the students provide a typed two–page progress report to the coordinators of the course and give a 5-minute presentation to fellow students registered in the course. These presentations are not marked and their only aim is to provide an opportunity for the students to prepare a short talk and to speak "in public" without a pressure of being judged. At the end of the term each student provides the course coordinators and his/her own supervisor with a typed report (about 20 pages) and one day is set aside for oral presentations (20 minutes plus 10 minutes for discussion) attended by all other students in the course, by all supervisors, and other faculty members from the Department. The final grade is a prescribed average of the term and the report mark (provided by the supervisor) and the presentation mark (provided by all faculty members present at the talks). The popularity of the course is increasing and in 2004 the number of students registered was 15 – the limit set by the ability to accommodate all presentations in one day.

- Several faculty members involve undergraduate students in their research. In case of the summer research the students are subsidized by "NSERC Student Research Grants" (13 students were awarded these grants for the Summer 2004). Other sources of support are from Alberta Energy Research Institute (one student in summer 2003),

NINT (one student in summer 2004 – the research in this case will be the continuation of the Phys 499 project), ICORE, STEP (ask D. Schmitt for the full name), etc. In almost all cases the students' salaries are augmented from the individual researchers' NSERC grants. Usually, the students involved in the research are in their 3rd or 4th year but in exceptional cases younger students are involved too – in one case the 1st year student involved in the summer research continued on a part time basis during the full academic year to follow. Sometimes, younger students volunteer to be involved in experimental research on a voluntary basis with no or rather symbolic pay. Some of the faculty members in the Department employ students from the Faculty of Engineering or act as supervisors in a project course offered there. Students in Geophysics are involved in field works (Rocky Mountains Foothills, South West British Columbia, Alaska). More time than was given to prepare this report would be needed to collect specific data from all faculty members in the Department and organize them into a detailed report.

- The Department of Physics offers a Colloquium every Friday during the school year. It is a series of talks by a researchers (usually invited from outside) addressed to all members of the Department and aimed at the level appropriate for senior undergraduate students. Fourth year students are expected to attend (graduate students are requested) and, indeed, they attend quite enthusiastically. The topics range from pure physics, astrophysics, through medical physics, physics education, to philosophy and relation between physics and other areas of human activity (like business, arts, etc.).

- The Department of Physics has four research focus areas: Condensed Matter, Subatomic, Astrophysics, and Geophysics. Medical Physics, although outside the formal structure of the Department is also present. The Department offers undergraduate programs in several flavors matching the above areas. Undergraduate students registered in these programs or intending to register are encouraged to attend the seminars and informal research meetings organized within the areas.

Edmonton, May 10, 2004