School of Arts & Science

DEPARTMENT OF CHEMISTRY & GEOSCIENCE

Chemistry 251
Immunology

Fall Semester, 2012

COURSE OUTLINE

This course describes the basic concepts of immunology and the application of immunochemistry to molecular, medical and veterinary biotechnology. Topics include antigens and antibodies, immune responses, vaccines, antibody diagnostics, immunosuppression, hypersensitivity, transplants, cancer, auto-immune diseases, immunodeficiencies (including AIDS), and current immunological techniques. (T)

This outline may not be on-line indefinitely. It is recommended students keep this copy for their records.

1. Faculty Information

(a) Instructor — Jamie Doran, Ph.D.

(b) Office hours — Monday, 12:30 to 1:00 pm
Monday, 2:30 to 3:20 pm
Wednesday, 12:30 to 1:00 pm
Wednesday, 2:30 to 3:20 pm
Thursday, 12:30 to 1:00 pm
Thursday, 2:30 to 3:20 pm
Friday, 1:30 to 3:20 pm

Students are welcome whenever my office door is open.
Appointments may be made to meet at times other than those listed above.
Office hours will be extended prior to exams.

(c) Office — F350C, Fisher Building, Lansdowne Campus

(d) Phone — 250.370.3441

(e) E-mail — jdoran@camosun.bc.ca

2. Intended Learning Outcomes

- Students successful in this course will be able to evaluate fundamental aspects of the human immune system, and relate these to a wide variety of immunologically-based clinical conditions including allergies, transplant rejection and acceptance, autoimmune diseases, and immunodeficiencies including AIDS.

- Students will be able to compare and contrast various types of antibody-based diagnostic tests, and various vaccine formulations.
- Students will have the hands-on experimental skills required to conduct the most commonly used immunological techniques including enzyme-linked immunosorbent assays (ELISA), latex bead agglutination assays, and Western-blotting detection of antigens.
- Students will have the ability to evaluate experimental design, design control experiments, and interpret data arising from basic immunological technologies.
- Students will be capable of working in a level-1 biosafety laboratory.
- Students will be experienced in the preparation, handling and storage of many types of solutions, buffers, reagents, and with equipment used immunological experimentation.

3. Required Materials

(a) **Course Text Book**

The Immune System. Third Ed. (2009). Au. Peter Parham. Garland Science. London.

This book is available in the Lansdowne Campus Book Store. Also, a copy of the textbook is available on loan through the Lansdowne campus reserve library.

Supplementary information from articles recently published in relevant journals, including Nature Immunology Reviews, will be provided as required, by request, or for general interest.

(b) Laboratory Manual and Selected Course Notes & Lecture Slides

A required booklet of experimental procedures, selected course notes and selected lecture slides from the textbook is available through the Lansdowne Campus Bookstore.

(c) General Supplies

Safety glasses Safety glasses are required when handling hazardous or potentially hazardous chemicals, immunological reagents, or biochemicals. Students are required to provide their own safety glasses. Students lacking safety glasses when required will not be permitted to work in the laboratory.

Lab coats Lab coats are required for **all** experimental work in the laboratory. Students are required to provide their own lab coats. Students lacking lab coats will not be permitted to work in the laboratory.

Latex gloves Latex or other 'non-allergenic' gloves *will be available in the lab* and are to be used when appropriate to protect the skin from potentially hazardous chemicals or, more frequently, to protect labile biochemicals from contamination or becoming degraded by enzymes from the skin.

Calculator A scientific calculator is required at times in the laboratory, in class and during tests and exams. Each student is required to provide her or his own scientific calculator. Cell phone-based calculators cannot be used.

4. Course Content and Schedule

Credits	4 credits
In-class workload	6 hours per week • There are three 50-minute lectures per week. • Laboratory periods are 2 hours and 50 minutes.
Out-of-class workload	6 hours per week
Number of weeks	14 weeks
Pre-requisite	Chem 120 - College Chemistry 1

Course times and locations

Lecture times	Tuesday 9:30 to 10:20 AM Fisher Building, Room F360 Wednesday 9:30 to 10:20 AM Fisher Building, Room F360 Thursday 9:30 to 10:20 AM Fisher Building, Room F360
Laboratory Periods*	Tuesday 2:30 to 5:20 PM Fisher Building, Room F360

**Alternatively, this 3 h time period is used to host two term exams and a final exam review. Please see the laboratory and term test schedule below.*
Some of this time period will be used for presenting lecture material during the first four weeks. Subsequently, lecture time will be used to complete experiments or discuss the previous day's lab results later in the semester.

Lecture Outline

HISTORICAL PERSPECTIVE
This topic is briefly introduced in the introduction (pages1-2) to Chapter One of The Immune System, 3rd ed. *by P. Parham. More extensive reading relevant to the initial lectures is provided in the selected course notes in the course package See "Historical Perspective on the Filed of Immunology' on pages 186 to 196.*

- Early historical evidence of immunity in humans

    - Meaning of the term 'immunity'
    - Recognition of the four basic tenants of adaptive immunity
- Variolation & the early evidence of vaccination
- Development of Jenner's small pox vaccine
- Development of the field of immunology
    - Louis Pasteur (1860's- 1890's) creates the field of immunology with seminal experiments demonstrating vaccination and acquired immunity in animals and humans.
    - Pasteur and Koch compete to create widely-accepted vaccines.
    - Metchnikoff establishes the field of cellular immunology (1880's)
    - Nuttal (1888) & Von Behring (1888-1890's): humoral immunity
    - Wright (1903): synergy of cellular and humoral immunity.
    - Paul Erlich (early 1900's-1915): furtherance of understanding.
    - Border: immune responses to non-pathogenic cells
    - Lansteiner: blood group ABO antigens.
    - Ramon (1928): toxoids (attenuated chemicals) as vaccines
    - Kabat (1930's): isolated immunoglobulins (antibodies) from blood
    - Chase (1940's): demonstrates transfer of cellular immunology
    - (*Note the list of Nobel Prize winning immunologists on page 226*.)
    - A history of vaccine use proves the efficacy of stimulating immunity to prevent major human infectious diseases.

GENERAL ROLE FOR THE IMMUNE SYSTEM IN MAINTAINING BODY INTEGRITY
Refer to Chapter 1, sections 1-1, 1-2, 1-5, 1-6 & 1-8 to 1-13

- Challenges to health: infectious organisms, cancer, toxins
- Innate immunity 'versus' adaptive immunity
- The lymphatic system
    - Primary and secondary lymphatic tissues
    - Structure and function of the lymphatic system as it relates to immunity
- Primary immune responses vs. secondary immune responses
- Introduction to Protective Immunity & Vaccination

THE INNATE IMMUNE RESPONSE
Refer to:
Chapter 1, sections 1-3, 1-4 & 1-7;
Chapter 2, sections 2-1, 2-5, 2-10, 2-11, 2-13 to 2-16, 2-2, 2-3, 2-6 to 2-9, 2-18, 2-17, 2-20 to 22;
Chapter 9, sections 9-17 & 9-19;
"Innate Immunity"' on pages 193 to 200 in the selected course notes in the course package.

- General characteristics of nonspecific physical and chemical defenses
    - Physical barriers
        - Skin and mucous membranes
    - Defensive chemicals
        - pH, lysozyme, iron-binding compounds, O_2
    - Natural bacterial flora and microbial antagonism
- White blood cells (leukocytes) involved in innate immunity
    - Phagocytic cell types: monocytes & macrophage, neutrophils (PMN's), dendritic cells, Langerhans cells
    - Nonphagocytic leukocytes: eosinophils, natural killer cells

    - Inflammatory leukocytes: mast cells, basophils
    - Lymphocytes: B-cells and T-cells
    - Origins of myeloid and lymphoid cell lines
- The innate, acute, inflammatory response
    - Constriction and local dilation of vessels
    - Roles for cells and soluble factors from the blood
    - Margination, extravasation (diapedesis), chemotaxis
    - Mast cell activity, soluble mediators
- The process of phagocytosis by macrophage
    - Antigen presentation links innate immunity with adaptive immunity
    - Oxygen-dependent and oxygen-independent killing mechanisms
    - Microbial strategies for the prevention of phagocytic killing
- Complement
    - Classical complement pathway
    - Alternative complement pathway
    - Lectin-mediated complement activation pathway
    - Roles of products of complement activation and other acute phase proteins in the inflammatory response and other aspects of immunity.
- Other humoral factors involved in innate immunity
    - C-reactive protein
    - Chemokines
    - Adhesion molecules
    - Toll-like receptors
    - Interferons α and β
- Cytokines
    - General nature and characteristics
    - Autocrine and paracrine functions
    - Classic characteristics: pleotrophy, redundancy, synergy, antagonism
- Natural killer (NK) cells
    - NK-cells: roles in innate immunity: killing mechanism

ADAPTIVE IMMUNITY & THE PRINCIPLE OF CLONAL SELECTION

Browse Chapter 3 for a general overview of material detailed in following chapters.

- Basic nature of antibodies & T-cell receptors
- Antigens, immunogens, and haptens
    - Epitopes (antigenic determinants)
    - Characteristics and properties of immunogens
    - Experimental conditions that affect the immunogenicity of immunogens
    - Vaccination conditions that affect the immunogenicity of immunogens

ANTIBODIES - STRUCTURE & DIVERSITY

Refer to Chapter 4, sections 4-1 to 4-16.

- Antibodies
    - Structure and function of a prototypic, divalent Ab molecule
        - ◊ Fab and Fc fragments
        - ◊ Globular constant domains
        - ◊ Variable and hypervariable (CDR) regions
    - Isotypes (classes) of antibodies

        - ◊ Classes of heavy and light chains
        - ◊ Immunological characteristics and functions

- Genetics of antibody diversity Antibody production by B-cells
    - Multi-gene organization of immunoglobulin genes
    - Variable region gene rearrangements
    - Generation of antibody diversity
    - Class switching

B-CELL ACTIVATION & ANTIBODY EFFECTOR FUNCTIONS

Refer to:

Chapter 6, Introduction, sections 6-1 & summary (browse chapter for interest);

Chapter 9, sections 9-1 to 9-17 & 9-20 to 9-25;

Chapter 10, sections 10-5 to 10-9, 10-11 to 10-19.

- Development & processing of B-cells
- Antibody production by B-cells
    - Clonal selection and antibody synthesis
    - B-cell receptors and antigen binding
    - B-cell activation and maturation
        - Plasma cells
        - Memory B-cells
    - Affinity maturation
    - Relationship of affinity maturation to class switching
    - Relationship of affinity maturation to memory B-cells
- Antibody effector functions
    - Roles as adaptor molecule
    - Roles specific to classes (isotypes) of antibodies
- Antibody interactions with Fc receptors on macrophage, mast cells, basophils, eosinophils and natural killer (NK) cells.
    - ADCC (antibody-dependent cell-mediated cytotoxicity)
- B-cell Receptors & cell adhesion molecules
- Role of CD4 Helper T_H2-cells in antibody production
- Role of CD4 Helper T_H2 -cells in CD4 B-cell activation
- T-independent B-cell antigens
- Role of the lymphatic system
- The role of T-helper cell - B-cell interactions
    - Affinity maturation and isotype switching
    - Prevention of harmful effects of affinity maturation

T-CELL ANTIGEN RECOGNITION AND ACTIVATION, AND T-CELL MEDIATED IMMUNITY

Refer to:

Chapter 7, Introduction and sections 7-1, 7-8 & 7-13;

Chapter 5, Introduction and sections 5.1, 5-4, 5-5 to 5.17 (browse the rest of Chapter 5);

Chapter 8, Introduction and sections 8-1 to 8-6;

Chapter 10, sections 10-5 to 10-6, 10-19 to 10-23, & 10-28 to 10-29.

- Development and processing of T-cells.
- T-cell receptors

    - T-cell receptor diversity
    - Role of αβ receptors
    - role of γδ receptors
- MHC Presentation and T-cell Surface Proteins CD4 and CD8
    - Endogenous antigen processing
    - Exogenous antigen processing
    - Role of CD4 in recognition of MHC II
    - Role of CD8 in recognition of MHC I
    - 'T-cell restriction'
    - MHC polymorphism
- CD4 & CD8 T-cell subclasses
    - Cytotoxic T-cells, helper T-cells, regulatory T-cells
    - Clonal selection applies to cytotoxic T-cells
    - MHC I presentation & Tc-cell Activation
    - MHC I presentation & Tc-cell Activation
    - Roles of antigen-presenting cells (APC's)
        - Macrophage
        - Dendritic cells
        - Langerhans cells
        - B-cells
- Adhesion molecules: CD molecules, selectins, integrins, toll-like receptors
- Role of CD4 Helper T_H1-cells in CD8 cytotoxic T-cell activation
- Activity of cytotoxic CD8 T-cells
- Role of CD4 Helper T-cells in CD8 cytotoxic macrophage activation
- Role of CD4 Helper T_H2 -cells in CD4 B-cell activation
- T_H1 vs. T_H2 Responses
    - Humoral vs. cellular immune responses
    - Cytokine profiles
    - Polarization (humoral vs. cellular) of immune responses
    - Functions of cytokines in mediating polarization
- Activity of cytotoxic CD8 T-cells

EVASION OF THE IMMUNE SYSTEM BY PATHOGENS

Refer to:
Chapter 11, sections 11-1 to 11-25;
Chapter 10, sections 10-1 to 10-4.
Handout materials will present very recent developments.

- Influenzae virus
- Trypanosomes
- Herpes virus
- Other pathogens

IMMUNODEFICIENCY

Refer to Chapter 11, sections 11-8, 11-11 to 11-25.
Handout materials will present very recent developments.

- Primary immunodeficiencies
- Secondary immunodeficiencies
    - HIV & AIDS

HYPERSENSITIVITY (Allergy)

Refer to Chapter 12, sections 12-1 to 12-24.

Handout materials will present very recent developments.

- The nature of hypersensitivity and allergens
- Types of hypersensitivity
    - Immediate-type hypersensitivity
        - Type 1 - Anaphylactic hypersensitivity
            - ◊ Systemic anaphylaxis
            - ◊ Localized anaphylaxis
        - Type 2 - Antibody-dependent cytotoxicity hypersensitivity
        - Type 3 - Complex-mediated hypersensitivity
            - ◊ Systemic
            - ◊ Localized
    - Delayed type hypersensitivity
        - Type 4 - Cell-mediated hypersensitivity

AUTOIMMUNITY

Refer to Chapter 13, sections 13-1 to 13-12, 13-13 to 13-17, 13-20 to 13-26.

Also refer to the Selected Course Notes.

Handout materials will present very recent developments.

- Major sources of autoimmunity
- Autoimmune diseases
    - Tissue-specific diseases
        - Aspermatogenesis
        - Sympathetic opthamalia
        - Hashimoto's thyroditis
        - Insulin-dependent diabetes
        - Autoimmune anemias
            - Pernicious anemia
            - Hemolytic anemias
        - Goodpasture's syndrome
        - Graves disease
    - Systemic autoimmune diseases
        - SLE (Lupus)
        - MS
        - Rheumatoid arthritis

VACCINES

Refer to Chapter 14, sections 14-1 to 14-10.

Handout materials will present very recent developments.

- Needs, benefits, and potential risks
- Type of vaccines
    - Killed or otherwise inactivated vaccines
    - Live attenuated vaccines
    - Subunit vaccines

        - Purified biomolecules
        - Recombinant vaccines
        - Heterologous vaccines
        - Peptide vaccines
        - DNA vaccines

TRANSPLANTATION IMMUNOLOGY

Refer to Chapter 15, sections 15-1 to 15-7, 15-9, 15-11, 15-18, 15-24 & 15-25.
(Browse the remainder of Chapter 15).

- Autograft, isograft, allograft, xenograft
- Privileged sites & privileged tissues
- Graft rejection
    - Hyperactive rejection
    - Acute rejection
        - First-set rejection
        - Second-set rejection
    - Chronic rejection
- Prevention of rejection
    - Tissue typing
    - Immunosuppressive agents
- Clinical transplantation
    - Current status
    - Graft vs. host reaction
- Immunosuppression
    - Immunological silence
        - Central tolerance
            - ◊ Thymic processing
            - ◊ Neonatal tolerance
        - Peripheral tolerance
    - Acquired immunotolerance
        - Low-zone tolerance
        - High-zone tolerance
        - Immunotolerance created by certain immunization regimes
        - Natural acquisition of 'immunotolerance' in people
- Blood Group Antigens
    - Rh antigens and fetal hemolytic disease
    - ABO antigens and compatible blood donors

CANCER IMMUNOLOGY

Refer to Chapter 16, sections 16-1 to 16-14.
Handout materials will present very recent developments.

- Tumour-Specific transplantation antigens
    - Viral antigens
    - Chemically-induced tumour antigens
- Tumour-associated transplantation antigens
    - Carcinofetal antigens
    - Embryonic antigens
    - Alpha-feto protein antigen

- Immune response to tumours
- Cancer immunotherapy
    - Cytokine therapy
    - Interferon therapy
    - Tumour necrosis factor therapy
    - Monoclonal antibody-based therapies
    - Anti-cancer vaccines

Additional laboratory-lecture topics in Immuno-Diagnostic Formats:

Radioimmunoassay (RIA)
Immunofiltration assays
Immunochromatographic assays
Affinity chromatography
Immuno-electron microscopy
Immuno-fluorescence microscopy
Fluorescence-activated cell sorter.

Laboratory and Term Exam Schedules

Week 1 Tuesday, September 4th.

Organization of the laboratory portion of the course; Perspective on the inter-relatedness of experiments; Overall lab orientation; Explanation of proper use of a variety micropipettors and other equipment.

Lecture material will also be presented in this initial lab period.

Week 2 Tuesday, September 11th.

Gel Immunodiffusion and the Identification of Antigens by Precipitin Reactions

Pre-Lab Talk: Nature of Precipitin Reactions

Experiment 1. The Ouchterlony Reaction

Experiment 2. The Radial Immunodiffusion Assay

Lecture and lab-lecture material also will be presented in this lab period.

Week 3 Tuesday, September 18th.

Experiment 1. (continued). Interpretation of the Ouchterlony Reaction

Experiment 2. (continued). Interpretation of the Radial Immunodiffusion Assay

Post-Lab Discussion - Interpretation of Precipitin Reactions

Pre-Lab Talk - Nature of Agglutination Reactions

Experiment 3. Use of a Latex Bead Agglutination Assay to Identify <u>Aeromonas salmonicida</u>, a Bacterial Pathogen of Salmon and Trout.

Lecture and lab-lecture material will be presented in this lab period.

Week 4 Tuesday, September 25th.

Experiment 4. Detection of <u>A. salmonicida</u> Antigens and Determination of Anti-<u>A. salmonicida</u> Polyclonal Antibody Titre Using an Indirect Enzyme-Linked Immunosorbent Assay (ELISA).

Pre-Lab Talk: Principles of ELISA.

Part I. Coating of microtiter plate wells with antigens.

Lecture and lab-lecture material will be presented in this lab period.

Week 5 Tuesday, October 2nd.

Experiment 4. Detection of* <u>A. salmonicida</u> *Antigens and Determination of Anti-* <u>A. salmonicida</u> *Polyclonal Antibody Titre Using an Indirect Enzyme-Linked Immunosorbent Assay (ELISA).

Part II. Conducting the ELISA.

Interpretation and discussion of ELISA results will occur in the following lecture.

Week 6 **Tuesday, October 9th. Term Test #1**

Week 7 Tuesday, October 16th

Pre-Lab Talk: Western Blotting for the Detection of Specific Antigens.

Experiment 5. Western Blotting Analysis of* <u>Aeromonas salmonicida</u> *Proteins.

Part I. SDS-polyacrylamide gel electrophoresis separation of proteins.

Wednesday, October 17th. (the following lecture period)

Experiment 5. Western Blotting Analysis of* <u>A. salmonicida</u> *Proteins.

Part II. Electrophoretic transfer of proteins onto nitrocellulose

Week 8 Tuesday, October 23rd.

Pre-Lab Talk: Applications of the Western Blotting Technique

Experiment 5. Western Blotting Analysis of* <u>A. salmonicida</u> *Proteins.

Part III. Immuno-detection of antigens on Western blots

Week 9 Tuesday, October 30th.

Experiment 5. Western Blotting Analysis of* <u>A. salmonicida</u> *Proteins.

Post-Lab Discussion. Interpretation of Western Blotting results.

Experiment 6. Differentiation and Titre Determination of Atlantic Salmon and Rainbow Trout Sera Using Monoclonal Antibodies in an ELISA Assay

Part I. Dilution of antigens, and coating of microtiter plates.

Experiment 7. Monoclonal Antibody Production and Characterization

Pre-Lab Lecture: Creating Hybridomas for Producing Monoclonal Antibodies (MAbs)

Week 10 Tuesday, November 6th.

Experiment 6. Differentiation and Titre Determination of Atlantic Salmon and Rainbow Trout Sera Using Monoclonal Antibodies in an ELISA Assay

Part II. ELISA Assay.

Week 11 Tuesday, November 13th. **Term Test #2**

Week 12 Tuesday, November 20th.

Experiment 7. Monoclonal Antibody Production and Characterization

Pre-Lab Presentation: Introduction to techniques for the propagation of tissue cultures and use of laminar flow hood and biosafety hoods for sterile tissue culture work.

Lab Lecture - Comparative Look at Immunological Techniques used for Commercial Immunological Diagnostic Assays and in R&D

Week 13 Tuesday, November 27th.

Experiment 7. Monoclonal Antibody Production and Characterization

Part I. Propagation of Monoclonal Antibody Producing Hybridoma Tissue Cultures.

Students will be timetabled to attend the lab in a staggered fashion so everyone has the further time needed to learn and conduct tissue culture techniques properly.

Week 14 Tuesday, December 4th.

Experiment 7. Monoclonal Antibody Production and Characterization

Part II. Immuno-chromatography Characterization of the MAb Classes and Subtypes in the Hybridoma Tissue Culture Supernatants

Part III. Post-Lab Discussion.

Final Exam: The time & location will be published during the Fall Semester.

5. Basis of Student Assessment (Weighting)

(a) **Laboratory Experiments**

Attendance in the lab periods is mandatory. No laboratory experiment can be missed without an acceptable reason submitted in writing, such as a suitable note from Medical Doctor.

NB. There are no laboratory reports to be handed but *students are responsible for understanding the principles, technical bases, and results of each experiment*. <u>These aspects of the laboratory work will be subject to examination on the term exams and the final exam.</u>

(b) **Term Exams**

Term Exam #1

This exam covers relevant material from approximately the first third of the course, including lab material. The delineation of material students are responsible for with regard to this exam will be provided in class about one week before the date of the exam. This is a 110 minute test written on **<u>Tuesday, October 9th</u>** in room F360 from 2:30 to 4:20 PM. The value this exam contributes to the final grade is **30%.**

Term Exam #2

This exam covers relevant material from approximately the second third of the course including lab material. The delineation of material students are responsible for with regard to this exam will be provided in class about one week before the date of the exam. This is a 110 min. test written on **<u>Tuesday, November 13th</u>** in room F360 from 2:30 to 4:20 PM. The value this exam contributes to the final grade is **30%**.

If either of the term exams is missed due to illness or for any other justifiable reason (accompanied by appropriate documentation), a student may either take a substitute test to be written at a mutually agreeable time, or choose to add the percentage value of that midterm exam (30%) to the percentage value of the final exam.

(d) Final Exam

The final exam is a comprehensive exam that includes components from the laboratory section of the course.
The value this exam contributes to the final grade is **40%**.
The time and location of the final exam will be published by the College during the Fall Semester. *(Please note that the exam time and date cannot be changed to accommodate vacation plans.)*
Attendance at the final exam is mandatory. Appropriate documentation must accompany any explanation for absence if an incomplete grade (I grade) is warranted.

6. Grading System

Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
90-100	A+		9
85-89	A		8
80-84	A-		7
77-79	B+		6
73-76	B		5
70-72	B-		4
65-69	C+		3
60-64	C		2
50-59	D		1
0-49	F	Minimum level has not been achieved.	0

Temporary Grades

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy at **camosun.ca** or information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	*Incomplete*: A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family.
IP	*In progress*: A temporary grade assigned for courses that are designed to have an anticipated enrollment that extends beyond one term. No more than two IP grades will be assigned for the same course.
CW	*Compulsory Withdrawal:* A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement.

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy E-1.5 at **camosun.ca** for information on conversion to final grades, and for additional information on student record and transcript notations.

7. **Recommended Materials or Services to Assist Students to Succeed Throughout the Course**

   A reading guide to the course text is provided for each topic (above). Supplementary course notes and copies of lecture slides that primarily present figures or tables from the text are provided in the course manual which includes the laboratory experiment protocols. These notes support lectures and laboratory experiments by the provision of material on subjects that are not addressed in the sufficient detail in the text, or are addressed in less detail or from a different perspective. The copies of many selected lecture slides that present figures, tables or other complex or somewhat information-intensive materials will facilitate efficient note taking, and promote in-class learning and discussion.

LEARNING SUPPORT AND SERVICES FOR STUDENTS

There are a variety of services available for students to assist them throughout their learning. This information is available in the College Calendar, Registrar's Office or the College web site at http://www.camosun.bc.ca

Please Note:

Students may not use recording devices in the classroom without the prior permission of the instructor or DRC. The instructor's permission is not required when the use of a recording device is sanctioned by the College's Disabilities Resource Centre for Students in order to accommodate a student's disability, and when the instructor has been provided with an instructor notification letter which specifies the use of a recording device. Recordings made in the classroom are for the student's personal use only, and distribution of recorded material is prohibited.

ACADEMIC CONDUCT POLICY

There is an Academic Conduct Policy. It is the student's responsibility to become familiar with the content of this policy. The policy is available in each School Administration Office, Registration, and on the College web site in the Policy Section.

www.camosun.bc.ca/divisions/pres/policy/2-education/2-5.html