New Course Outline

- The PharmD Approval Process for New Course Outlines document provides for more information on next steps and approval timelines.
- The Course Outline Submission Overview document provides more detailed guidelines on course learning objectives, topic outlines/scheduling requirements, and assessment methods.
- The AFPC Educational Outcomes for Professional Programs document provides complete information on roles and key competencies for Pharmacy Degree Programs.

**Course Number:** PHM140H1

**Course Title:** MOLECULAR PHARMACOLOGY

**Outline Version Code:**

**Course Description:**

Many drugs act via the receptors and other proteins that mediate cellular signalling. Such signalling proteins can be grouped into several families on the basis of their structural and functional similarities. Examples from each family are examined at the molecular level from a pharmacological, biochemical and biophysical point of view for insight into their structure, their mechanism of action, their modulation by drugs and the underlying dysfunctions toward which the drugs are directed. Basic principles of molecular pharmacology are introduced as a tool for decoding the relationship between dose and response across all families, with an emphasis on the explicit nature of concepts such as potency and efficacy.

**Semester:**

☐ Fall  ☐ Winter  ☐ Summer

**Course Type:**

☐ Elective  ☐ Selective  ☒ Mandatory

1. **Course Learning Objectives:**

Upon completion of this course, students will have achieved the following level of learning objectives:

- Introductory = knowledge and comprehension of concepts, definitions
- Intermediate = application of concepts to simple situations
- Advanced = application of concepts to more complex situations with ability to synthesize and evaluate
**Knowledge**

**Introductory Level:**

Classify the different families of neurohumoral receptors and related proteins that mediate cellular signalling. Describe their mechanisms of action in molecular and mechanistic terms, and indicate how their dysfunction can lead to disease. Explain the actions of agonists and antagonists in terms of fundamental physical-chemical properties and in the context of pharmacological and biophysical properties such as selectivity, potency, efficacy and the current-voltage relationship. Describe and differentiate among different theoretical models that have been developed to account for the functioning of receptors and for the relationship between dose and response. Describe and discuss the nature and importance of processes in which multiple proteins are recruited to and discharged from a dynamic complex during signalling.

**Intermediate Level:**

Interpret biophysical, biochemical and pharmacological data pertaining to receptor-related effects, their dysfunction in disease and their modulation by drugs. Deduce the underlying molecular and mechanistic causes of disease-related changes in such effects, and predict strategies for therapeutic intervention.

**Advanced Level:**

Formulate, derive and apply quantitative mechanistic models that can account for dose-dependent biophysical, biochemical and pharmacological effects.

**Skills**

**Introductory Level:**

Reflect upon the level of complexity that is inherent in biological systems. Appreciate the immense investment in time, money and thought that underlies our understanding of such systems, their dysfunction in disease and their modulation through therapeutic intervention.

**Intermediate Level:**

**Advanced Level:**
2. Rationale for Inclusion in the Curriculum:

Informed therapeutic intervention is based upon a knowledge of structure and mechanism at the molecular level. That in turn derives from advances in biophysics, biochemistry, immunology, molecular genetics and related sciences as they pertain to fields such as neuroscience and pharmacology. The course therefore builds on the student’s knowledge in the basic sciences, particularly with regard to the structure and function of proteins, to provide an understanding of how drugs act at the molecular level.

The material complements that in disciplines focused on other aspects of therapeutic intervention, such as pharmacokinetics and pharmaceutics, and it provides a unifying framework for courses in which therapeutic agents are discussed in terms of their physiological, pharmacological or toxicological effects.

3. Pre-requisites:

Physiology, Metabolic Biochemistry and Immunology

4. Co-requisites:

5. Course Contact Hours and Teaching Methodologies:

<table>
<thead>
<tr>
<th>Teaching Methodology</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Didactic (lecture)</td>
<td>39</td>
</tr>
<tr>
<td>Large group problem-based/ case-based learning (group size: 240)</td>
<td></td>
</tr>
<tr>
<td>Laboratory or Simulation</td>
<td></td>
</tr>
<tr>
<td>Tutorial/Seminar/Workshop/Small Group (group size: )</td>
<td>7-13</td>
</tr>
<tr>
<td>Experiential</td>
<td></td>
</tr>
<tr>
<td>On-line</td>
<td></td>
</tr>
<tr>
<td>Other (please specify):</td>
<td></td>
</tr>
<tr>
<td><strong>Total Course Contact Hours</strong></td>
<td><strong>39</strong></td>
</tr>
</tbody>
</table>
6. Estimate and description of student’s weekly out-of-class preparation time excluding exam preparation:

There is no obligatory preparation time.

7. Topics Covered and Lecture Specific Learning Objectives

**Week 1**  
**Lecture Topic:** Introduction to signalling and signalling proteins, biochemical classification of signalling proteins into families

**Lecture Learning Objectives:**

Here and throughout the course, there is an emphasis on principles and understanding. Concepts and broad themes are described in molecular terms and presented in the context of key observations taken from the scientific literature. The intent is not only to introduce the ‘facts,’ such as they are, but also to impart an appreciation of the scientific process and the nature of the information that constitutes the basis of present knowledge. Limits to current understanding, uncertainty over the interpretation of data, and alternative hypotheses are pointed out from time to time in an effort to encourage a critical approach to the subject. A central aim is to encourage a conceptual grasp that will outlive the specific and perhaps transient details of today to assist in understanding those of tomorrow.

**Week 2**  
**Lecture Topic:** Basic concepts in molecular pharmacology

**Lecture Learning Objectives:**

Agonists, antagonists and inverse agonists; potency, intrinsic activity and efficacy; mechanisms of signalling and its inhibition; measurement of binding and response

**Week 3**  
**Lecture Topic:** G protein-coupled receptors

**Lecture Learning Objectives:**

**Week 4**  
**Lecture Topic:** G proteins and effectors.

**Lecture Learning Objectives:**
Week 5
Lecture Topic: G proteins and effectors, Mechanism of G protein-mediated signalling

Lecture Learning Objectives:

Week 6
Lecture Topic: Wnt, hedgehog and notch, Intrinsic tyrosine kinases

Lecture Learning Objectives:

Week 7
Lecture Topic: Intrinsic tyrosine kinases, Intrinsic guanylate cyclases

Lecture Learning Objectives:

Week 8
Lecture Topic: Biophysical characterisation of ion flux, Voltage-gated ion channels

Lecture Learning Objectives:

Week 9
Lecture Topic: Voltage-gated ion channels, Ion-gated ion channels

Lecture Learning Objectives:

Week 10
Lecture Topic: Ion-gated ion channels, Ligand-gated ion channels

Lecture Learning Objectives:

Week 11
Lecture Topic: Ligand-gated ion channels

Lecture Learning Objectives:
Week 12
Lecture Topic: Ligand-gated ion channels, Nuclear receptors

Lecture Learning Objectives:

Week 13
Lecture Topic: Nuclear receptors

Lecture Learning Objectives:

8. Assessment Methodologies Used:

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Course Learning Objectives Addressed</th>
<th>Assessment Method Used</th>
<th>Percent of Course Grade</th>
<th>For Group Work: Individualized or same mark for all group members</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Assignment</td>
<td>☐ Presentation</td>
<td>☐ Participation</td>
<td>☐ Mid-term</td>
<td>☐ Final Exam</td>
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</tr>
</tbody>
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Expectation for pass grades for all Pharmacy courses is 60%
9. Policy and procedure regarding late assignments/examinations/laboratories:

To receive consideration for any absence, a student must submit a petition and appropriate documentation to the Registrar of the Leslie Dan Faculty of Pharmacy (brenda.thrush@utoronto.ca, 416-978-2873). Eligibility will be determined according to the policy of the Leslie Dan Faculty of Pharmacy for missed examinations. Please consult the calendar for further details. If a petition has not been filed and approved, the absentee will receive a grade of zero for the missed test or examination. Absence from Term Tests: (a) Should a student miss one of the mid-term tests, the mark on each section will be taken as that obtained on the corresponding section of the final examination. (b) Should a student miss both of the mid-term tests, the mark on each section will be taken as that obtained on the corresponding section of a make-up examination that normally is held early in August. Absence from the Final Examination: Should a student miss the final examination, the mark will be taken as that obtained on the make-up examination and combined with the mid-term marks to obtain an overall grade for the course. Pending the outcome of the make-up examination, the grade in PHM 140H1 will be shown as DNW on ROSI. The make-up examination specified above also will serve as the supplemental examination; further details regarding the examination are given in Section 16. Absence from the make-up examination: Should a student miss the make-up examination, the next opportunity will be the final examination in April or May of the next academic year. In that event, the student will be held responsible for any changes in the content of the course during the intervening year.

10. Policy and procedure regarding missed assignments/examinations/laboratories:

A student who fails to obtain an overall grade of at least 60% is deemed to have failed the course. Eligibility to take a supplemental examination will be determined in accord with the policies of the Leslie Dan Faculty of Pharmacy. A single examination will serve as the supplemental examination and the make-up examination described in Section 15. It will be held during the period selected for supplemental examinations in the Leslie Dan Faculty of Pharmacy, normally in early August. The questions will be drawn from all sections of the course, and marks will be allocated among the different sections in direct proportion to the number of lecture-hours. Individual sections may be written or oral, as determined by the course coordinator in consultation with the individual lecturers. Decisions regarding the format generally will be made during the month preceding the examination. A student who is absent from the supplemental examination may seek permission to write a make-up examination by submitting a petition and appropriate documentation to the Registrar of the Leslie Dan Faculty of Pharmacy (brenda.thrush@utoronto.ca, 416-978-2873). Such a make-up examination will be constituted as described above for the supplemental examination and held prior to the start of the next academic year.

11. AFPC Education Outcomes addressed (check all those that apply):

- Refer to AFPC Educational Outcomes for Professional Programs for further information about the role and key competencies.

As Care Providers, pharmacy graduates:

**CP1 – Practice within the pharmacist scope of practice and expertise**

☒ CP1.1 Apply knowledge from the foundational sciences to make decisions relevant to the contemporary and evolving scope of pharmacist practice;

☐ CP1.2 Integrate AFPC Communicator, Collaborator, Leader-Manager, Health Advocate, Scholar, and Professional roles in their practice of pharmacy;

☐ CP1.3 Recognize and respond to the complexity, uncertainty and ambiguity inherent in pharmacy practice;
CP1.4 Explain the benefits, risks and rationale associated with pharmacist-provided care as an important step in obtaining and documenting consent to pharmacist care;

CP1.5 Recognize and take appropriate action when signs, symptoms and risk factors that relate to medical or health problems that fall into the scope of practice of other health professionals are encountered.

CP2 – Provide patient-centred care

CP2.1 Collect, interpret, and assess relevant, necessary information about a patient’s health-related care needs;

CP2.2 Formulate assessments of actual and potential issues and in collaboration with the patient and other health team members as appropriate, prioritize issues to be addressed in a given patient encounter;

CP2.3 Create and document plans in collaboration with the patient and other health team members as appropriate, and make recommendations to prevent, improve or resolve issues;

CP2.4 Implement plans in collaboration with the patient and other health team members as appropriate, including:

- obtaining consent
- making a referral or consulting others
- adapting, initiating, renewing/continuing, discontinuing or administering medication as authorized
- dispensing and/or
- compounding and/or
- delegating/authorizing such tasks to others appropriately
- engaging the patient or care-giver through education, empowerment and self-management, and
- negotiating the role of pharmacy and non-pharmacy team members in continuity and transitions of care.

CP2.5 Follow-up by monitoring, evaluating progress toward achievement of the patient’s goals of therapy, adjusting plans in collaboration with the patient and health team members across the care continuum.

CP3 – Actively contribute, as an individual and as a member of a team providing care, to the continuous improvement of health care quality and patient safety

CP3.1 Recognize and respond to harm and potential harm from health care delivery, including patient safety incidents;

CP3.2 Adopt strategies that promote patient safety and address human and system factors;

As Communicators, pharmacy graduates:
CM1 – Communicate in a responsible and responsive manner that encourages trust and confidence

☐ CM1.1 Select and use oral, non-verbal and written communication strategies (tools, techniques, technologies, etc.) effectively so that the patient’s best interests are foremost;

☐ CM1.2 Provide timely, clear responses that are tailored to the context and audience;

☐ CM1.3 Express facts, evidence, opinions and positions accurately and effectively, with clarity and confidence;

☒ CM1.4 Listen, actively solicit and respond appropriately to ideas, opinions and feedback from others;

☐ CM1.5 Use language, pace, tone, and non-verbal communication that is suitable for:
   a) the intended outcomes of the communication, and
   b) the complexity, ambiguity, urgency and/or difficulty of a situation, conversation or conflict

☐ CM1.6 Seek and synthesize relevant information from others in a manner that ensures common understanding and where applicable, clarifies and secures agreement and/or consent;

☐ CM1.7 Compose and share oral, written, and electronic information in a manner that optimizes patient safety, dignity, confidentiality, and privacy.

CM2 – Communicate in a manner that supports a team approach to health promotion and health care

☐ CM2.1 Engage in respectful, empathetic, compassionate, non-judgmental, culturally safe, tactful conversations with patients, communities, populations, and health team members;

☐ CM2.2 Demonstrate awareness of the impact of one’s own experience level, professional culture, biases and power and hierarchy within the health team on effective working relationships, communication and conflict resolution with health team members and adapt the approach to the situation appropriately;

☐ CM2.3 Demonstrate accuracy and appropriateness of communication as well as respect for the role of other health team members when disclosing information about harmful or potentially harmful situations;

☐ CM2.4 In word and in action, convey the importance of teamwork in patient-centred care, patient safety, health care quality improvement and health program delivery.

As Collaborators, pharmacy graduates:

CL1 – Work effectively with members of the health team including patients, pharmacy colleagues and individuals from other professions

☐ CL1.1 Establish and maintain positive relationships;
☐ CL1.2 Recognize, respect and negotiate the roles and shared/overlapping responsibilities of team members;

☐ CL1.3 Join with others in respectful, effective shared decision-making.

**CL2 – Hand over the care of the patient to other pharmacy team members and non-pharmacy team members to facilitate continuity of safe patient care**

☐ CL2.1 Determine when and how care should be handed over to another team member;

☐ CL2.2 Recognize, respect and honour the negotiate shared and overlapping responsibilities of patients, pharmacy team members and other health members when handovers occur;

☐ CL2.3 Demonstrate safe handover of care, using oral, written, and electronic communication, during a patient transition to a different care provider or setting.

As **Leader-Managers**, pharmacy graduates:

**LM1 – Contribute to optimizing health care delivery and pharmacy services**

☐ LM1.1 Work with others to apply quality improvement strategies and techniques to optimize pharmacy care;

☐ LM1.2 Contribute to a culture of patient safety;

☐ LM1.3 Confirm the quality, safety, and integrity of products;

☐ LM1.4 Use health informatics to improve the quality of care, manage resources and optimize patient safety.

**LM2 – Contribute to the stewardship of resources in health care systems**

☐ LM2.1 Apply evidence and management processes to achieve cost appropriate care;

☐ LM2.2 Allocate health care resources for optimal patient care;

☐ LM2.3 Contribute to the management of finances and health human resources in pharmacy practice settings;

**LM3 – Demonstrate leadership skills**

☐ LM3.1 Demonstrate leadership skills to enhance pharmacy practice and health care.

**LM4 – Demonstrate management skills**

☐ LM4.1 Work with others to apply the principles of effective management and supervision of health human resources and medication use systems;

☐ LM4.2 Use effective strategies to manage and improve their own practice of pharmacy.
As Health Advocates, pharmacy graduates:

**HA1 – Respond to an individual patient’s health needs by advocating with the patient within and beyond the patient care environment**

☐ HA1.1 Work with patients to address determinants of health that affect them and their access to needed health services or resources;

☐ HA1.2 Work with patients to increase opportunities to adopt healthy behaviours;

☐ HA1.3 Incorporate disease prevention, health promotion and health surveillance into interactions with individual patients.

**HA2 – Respond to needs of communities or populations they serve by advocating with them for system-level change in a socially accountable manner**

☐ HA2.1 Work with community or population to identify the determinants of health that affect them;

☐ HA2.2 Participate in health promotion and disease prevention programs.

As Scholars, pharmacy graduates:

**SC1 – Apply medication therapy expertise to optimize pharmacy care, pharmacy services and health care delivery**

☐ SC1.1 Use knowledge and problem-solving to arrive at recommendations and decisions that are appropriate, accurate, and practical;

☐ SC1.2 Use professional experience to solve routine, previously encountered problems;

☐ SC1.3 Use established decision-making frameworks and apply learning required to manage new situations and problems.

**SC2 – Integrate best available evidence into pharmacy practice**

☐ SC2.1 Generate focused questions related to needs for information, recommendations and decisions in practice;

☐ SC2.2 Use systematic approaches in the search for best available evidence;

☐ SC2.3 Critically appraise health-related research and literature;

☐ SC2.4 Incorporate best available evidence in the decision-making process.

**SC3 – Contribute to the creation of knowledge or practices in the field of pharmacy**
☒ SC3.1 Apply scientific principles of research and scholarly inquiry;
☐ SC3.2 Apply ethical principles that underlie research and scholarly inquiry.

SC4 – Teach other pharmacy team members, the public and other health care professionals including students

☐ SC4.1 Provide effective education to others;
☐ SC4.2 Employ appropriate teaching roles when teaching others;
☐ SC4.3 Deliver effective feedback in teaching and learning situations;
☐ SC4.4 Use appropriate learning assessment and evaluation strategies when working with patients, team members, students and teachers.

As Professionals, pharmacy graduates:

PR1 – Committed to apply best practices and adhere to high ethical standards in the delivery of pharmacy care

☐ PR1.1 Exhibit professional behaviour whether face-to-face, in writing, or via technology-enabled communication. Professional; behaviour includes, but is not limited to:

  a) demonstrating honesty, integrity, humility, commitment, altruism, compassion, respect for diversity and patient autonomy;
  b) being accessible, diligent, timely and reliable in service to others;
  c) abiding by the principle of non-abandonment;
  d) maintaining appropriate interpersonal boundaries;
  e) maintaining professional composure, demeanor, and language even in difficult situations, and;
  f) maintaining privacy and confidentiality;

☐ PR1.2 Use ethical frameworks as one component of professional judgment;

☐ PR1.3 Recognize and respond to situations presenting ethical dilemmas, including conflicts of interest;

☐ PR1.4 Engage in activities that:

  a) protect the public, and;
  b) advance the practice of pharmacy.

PR2 – Able to recognize and respond to societal expectations of regulated health care professionals

☒ PR2.1 Take responsibility and accountability for actions and inactions;

☐ PR2.2 Demonstrate a commitment to patient safety and quality improvement;
☐ PR2.3 Honour the laws, ethical codes, and regulatory requirements (by-laws, standards, policies) that govern the self-regulated profession of pharmacy;

☐ PR2.4 Demonstrate an understanding of federal, provincial/territorial, and municipal laws, policies and standards that apply to pharmacy workplaces;

☐ PR2.5 Demonstrate an ability to maintain competence to practice through evaluating areas for improvement and planning, undertaking learning activities to address limitations in competence and/or performance and incorporating learning into practice;

☐ PR2.6 Identify and respond to unprofessional, unethical, and illegal behaviours in pharmacists, other pharmacy team members, and other health professionals.

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**PR3 – Committed to self-awareness in the management of personal and professional well being**

☐ PR3.1 Set professional and personal goals, priorities, and manage their time to balance patient care, workflow, and practice requirements;

☐ PR3.2 Examine, reflect upon, and manage personal attributes (knowledge, skills, beliefs, biases, motivations, emotions, etc.) that could influence self-development and professional performance;

☐ PR3.3 Adapt their practice of pharmacy to fulfill evolving professional roles;

☐ PR3.4 Recognize and respond to self and colleagues in need.