“Science is one of the very few human activities – perhaps the only one – in which errors are systematically criticized and fairly often, in time, corrected. This is why we can say that, in science, we often learn from our mistakes, and why we can speak clearly and sensibly about making progress there.”

– Karl Raimund Popper (1902-1994)

“No opinion should be held with fervour. No one holds with fervour that $7 \times 8 = 56$ because it can be shown to be the case. Fervour is only necessary in commending an opinion which is doubtful or demonstrably false.”

– Voltaire (1694-1778)

Class location and meeting times
Mon, Wed, & Fri: 1:30-2:20 pm, ALEX 218

Coordinator
Dr. Brad Hanna, Department of Biomedical Sciences, OVC Main Building room 1646D
Ext. 54534, e-mail: bhanna@uoguelph.ca

I. Rationale for the course:
Avoidable errors in experimental design, methodology, analysis and interpretation are surprisingly common in the published medical literature. It has been estimated that only about 20% of the medical research articles published in the 1990s and early 2000s are free of important flaws, leaving the conclusions of the remaining 80% in doubt. The situation appears to be improving, but only gradually. Even when good scientific evidence is available regarding a specific health issue, it is not necessarily used to guide clinical decisions; the information may not be considered at all, or flawed reasoning may enter into the decision-making process. Estimates of the percentage of North American medical procedures and technologies that are based on good scientific evidence have improved from about 15% in the 1970s to about 20% today. This suggests that the majority of the medical procedures now employed are of uncertain value to patients. These numbers reflect the situation in human medicine; in veterinary medicine the scientific foundation is even more limited. This course will address some of the major issues related to experimental design and methodology in the health sciences, and critical thinking as it relates to the use of medical knowledge. Selected issues that influence public perceptions of science in general will also be discussed.

II. Course Aims and Objectives
The general aims of this course are: (1) to assist participants in becoming more critical readers of the medical literature, (2) to enhance participants’ critical thinking abilities by exploring some of the most common errors of reasoning in everyday thought and in medicine in particular, and (3) to address selected issues related to scientific integrity and professionalism. Achievement of these aims will contribute to the ultimate goal of basing health sciences decisions, in research or in clinical practice, on the best available evidence.
This course is divided into three units. Specific Learning Outcomes by Unit:

**Critical Thinking: Logic & Reasoning**
By the end of this unit, students will:
- know the criteria of a good argument and be able to develop good arguments
- recognize common errors of logic and tactics for avoiding a good argument

**Critical Appraisal & the CONSORT Statement**
By the end of this unit, students will:
- be able to assess the quality of health sciences publications at an intermediate level
- be able to justify selected scientific procedures for the avoidance of bias
- understand the problems of publication bias and selective citation

**Scientific Integrity & Professionalism**
By the end of this unit, students will:
- develop informed opinions about ethical issues related to health sciences research, such as plagiarism, fabrication of data, selective citation of the literature, authorship, peer review, conflict of interest, etc.

**III. Format and Procedures:**
This is a lecture- and discussion-based course, with some independent components. Students are expected to participate in discussions and to conduct themselves in a scholarly and professional manner.

**IV. Recommended Reference Texts:**
(a) Unit 1: *Attacking Faulty Reasoning* (5th edition), TE Damer, Thomson-Wadsworth, 2005 (better than the 6th edn.).

**V. Calculation of Course Grades***
Critical thinking group assignments (written): 20%
Critical appraisal group assignments (oral): 40%
Group critiques of the oral presentations: 5%
Essay/short-answer format final exam: 35%

**Late assignments:** Groups may submit one late assignment (up to 1 week past the due date) without penalty during the semester. Additional late submissions without acceptable cause will be penalized 5% per day. Assignments not submitted within one week of the due date (without acceptable cause) will be assigned a mark of zero.

*Students must contribute their fair share to group work in order to earn marks associated with group activities (written assignments, oral presentations, and seminar critiques).

**VI. University Statement on Academic Integrity**
The University of Guelph takes a serious view of Academic Misconduct. Included in this category are such activities as cheating on examinations, plagiarism, misrepresentation, and submitting the same material in two different courses without written permission. **Students are**
expected to be familiar with the section on Academic Misconduct in the Undergraduate Calendar and should be aware that expulsion from the University is a possible penalty.

VII. Electronic Recording of Classes
The electronic recording of classes is forbidden without the prior written consent of the instructor. This prohibition extends to all components of the course, including, but not limited to, lectures and seminars, whether conducted by the instructor, a student, or any other designated person. When recordings are permitted they are permitted solely for the private use of the authorized student and may not be reproduced or disseminated in any manner without the express written consent of the instructor.

VIII. Accommodations for Students with Disabilities
Students should contact Student Accessibility Services to verify their eligibility for appropriate accommodations, and contact the course coordinator at the beginning of the course to discuss specific needs.

University Statement on Accessibility:
The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Centre for Students with Disabilities (now re-named Student Accessibility Services) as soon as possible.
For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or refer to the CSD website. The standard statements are available on the AVPA website (undergraduate courses) or from the Office of Graduate Studies (Graduate Courses).

IX. Course Schedule
The schedule will vary as needed to accommodate discussions and guest lecturers. The first section of the term will focus on critical thinking and the second section on critical appraisal of clinical trials. Unit 3, the smallest section of the course, will consist of special lectures and discussions throughout the semester.

X. Course Evaluation
Students will be asked to complete a questionnaire on the instructors’ teaching abilities. This information is required by the university to evaluate faculty performance for purposes of tenure and promotion. Administered by a third party rather than the instructors, these evaluations will be delivered to the instructors only after the final grades have been submitted to the Registrar’s Office. The numerical ratings from the form will be made available to the Chair for administrative purposes. If a student wishes the Chair to see his/her written comments in addition to the scores, he/she must include with those comments his/her name (legibly printed) and signature.

This document is subject to change with prior notification.