Department: PHAR

Course No.: 150

Credits: 3

Title: Toxic Chemicals and Health

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Content Area: CA 3 Science and Technology

Catalog Copy: Phar 150. Toxic Chemicals and Health.Second semester. Three credits. Not open to pharmacy students in the Professional Program. Morris. An elementary service course that which will provide an understanding of the issues and problems associated with evaluating human health risks from voluntary and involuntary exposure to toxic chemicals. An appreciation of toxic chemical risks as compared to other societal health risks, the processes of scientific risk assessment, and social management of toxic chemical risks will be gained.

Course Information:

a. Phar 150, Toxic Chemicals and Health, is a course designed to provide science and non-science majors with a conceptual understanding of the science of toxicology and how is it applied to make scientifically sound evaluations of the heath risks associated with exposures to toxic chemicals. By explaining the process through which information from a variety of scientific fields is integrated to make risk-benefit evaluations, the long-term goal is to provide students with the conceptual framework necessary to make informed decisions regarding the pollution and/or chemical contamination issues that they may face in a modern technologic society.

b. The course is presented as a lecture course with three exams and a cumulative final examination. Exam formats include multiple choice and short answer questions, depending on the size of the class. While the basic format is as a lecture course, the lecture often becomes an open student-initiated

discussion of a current pollution/environmental health issue. Since the faculty often serve on the state/federal advisory panels that recommend specific exposure standards, these discussions provide the students with critical insights into the issues that are balanced in making regulatory decisions. In addition to the faculty participating in the course, a doctoral student in the toxicology program is assigned as a teaching assistant to provide an opportunity for individual discussions/interactions. No suitable text is available, but extensive written materials are provided through handouts and/or WebCT.

c. The course is divided into three sections. The first section covers basic principles including dose-response relationships, chemical disposition in the body, biologic variability in response and sensitive populations. The second section relies on a basic medical science target-organ based approach to provide carefully selected specific examples for demonstration of important principles. The target organs include the respiratory system, the central nervous system, the reproductive system (including the developing fetus). The basic principles of chemical carcinogenesis are also included in this section. In the final third of the course, specific real-world risk assessment examples are provided in a format that elucidates how basic science principles are applied to make final decisions regarding "safe" exposure levels. Examples include workplace exposures (occupational standards), air/water pollution, drug toxicities, and food additives. Finally, the conceptual framework that is applied by federal and state regulatory agencies is described and an overview of the principles of risk communication is provided.

Meets Goals of Gen Ed: Acquire intellectual breadth and versatility. Since it is assumed that students possess minimal post-secondary scientific preparation, essential basic biomedical background concepts in chemistry, biology, and physiology will be presented and then integrated in the context of toxicological risk assessment. In presenting the health risks of chemicals, issues relating to historical background, pollutant exposure scenarios, regulatory strategies and public perceptions will also be discussed to promote general intellectual breadth.

Acquire critical judgment. Students will learn that chemical risk decisions are based on carefully assessment of risks and benefits. Such decisions are multifaceted and quite complex. Thus, the aim is for students to acquire critical judgment skills relative to benefits and risks associated with toxic chemical usage.

Acquire moral sensitivity. The determination of "acceptable" heath risk is in large part an ethical decision. The ethical basis for such decisions is explicitly discussed (e.g. voluntary versus non-voluntary exposure, risk versus remuneration in the workplace, etc.). By enhancing the students perspective

relative to the ethical nature of such decisions, this course is aimed at the acquisition of moral sensitivity relative to the complex issues associated with toxic chemical exposure in modern technologic society.

Acquire awareness of their era and society. The evaluation of toxic chemical risk benefit has evolved in the last century. Through examples selected to demonstrate the principles employed currently compared to those used over the last 100 years, the students shall acquire awareness of the current societal issues relative to use of toxic chemicals.

Acquire a working understanding of the processes by which they can continue to acquire and use knowledge. A constant theme in this course is the elucidation of principles that students can apply when faced with contamination/pollution issues in the future. The faculty are very explicit in indicating how past examples can be used to guide decisions in the future. The long-term expectation is not that students will necessarily be able to fully address the scientific issues, but to clearly indicate what questions informed individuals should ask of experts to allow themselves to make their own evaluations.

CA3 Criteria: Students will be provided with a biomedical orientation to the scientific evaluation of health risks from toxic chemicals. They will obtain a comprehensive understanding of how basic science knowledge (in

particular mechanism of action information) is integrated with exposure assessment and dose-response evaluation to formulate a comprehensive, scientifically sound risk assessment. This approach is constantly evolving, and students are provided with the state-of-the-art information in this area as well as with the historical background to place the current approaches in perspective. It is not possible to discuss every possible toxic chemical. Through use of carefully selected real-world examples, the aim is to provide a broad perspective of the contemporary scientific approaches used to risk assessment.

Our knowledge of toxic chemical health risks and how they are best evaluated has evolved, primarily through application of the scientific method to address these issues. This is most clearly elucidated to the students through examples that demonstrate the experimentation used to define the mechanisms of action as it relates to assessment of health risks to specific pollutants. The lectures describe how hypotheses are derived from existing data, and then tested through appropriate controlled experiments to advance knowledge. The standards of proof necessary to incorporate mechanistic information in the regulatory decision making process is also discussed. Drug/chemical toxicity provides an ideal subject area in which to elucidate these principles. For example, students will learn how mechanistic information was developed and used to prevent a second thalidomide-like scenario and how

mechanistic information was developed and then applied to the low dose risk extrapolation of for chemical carcinogens. A repeating theme in the course is that solid science (and application of the scientific method) is essential for sound risk evaluation.

There are many unresolved issues relative to toxic chemical health risk. In this arena most people prefer "black and white" arguments rather than the "shades of gray" that typically arise. Thus, a theme of the course is that uncertainty is a critical issue for many, if not all, risk evaluations. This can represent chemical specific issues or more generic issues, such as the most appropriate manner to estimate the risks of exposure to a carcinogen. The current state of the art is clearly defined in this course and future directions are highlighted. This is an aspect of the course that the students probably find most intriguing and the challenge for the faculty is to provide a clear understanding of the issues for which we have definitive answers versus those issues for which further study is needed.

Promoting commitment to continued learning in the field of toxic chemical risk evaluation is fairly straightforward, in large part because students relate personally with the subject matter. Most people are frightened by chemicals and their associated health risks, thus, continued curiosity in this field represents a compelling interest of most students in the course. The scientific process for risk evaluation is quite different from what is commonly perceived. By providing the foundation of principles upon which such evaluations are made, students become aware that there are, indeed, fundamental, common sense principles that can be applied to evaluate safety. By reiterating these principles and how they have been applied in real world situations, the final third of the course is explicitly designed to provide the contextual framework for students to pursue life-long learning in the field.

Role of Grad Students: A graduate assistant is assigned to this course to provide answer student questions and/or tutoring if a faculty member is unable to do same.