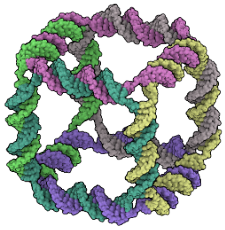

NANO*4100 Biological Nanomaterials Fall 2017
Course Outline

This course introduces nanoscience students to biological molecules and the amazing variety of self-assembled biological nanostructures, nanomachines and nanomaterials.

Lecturer:

Professor John Dutcher, MacN 451, ext 53950, dutcher@uoguelph.ca

John's research focuses on developing a fundamental understanding and predictive power for the physical properties of polymers, biopolymers and bacterial cells at surfaces and in thin films. He applies a broad range of surface-sensitive experimental techniques and fundamental, physics-based strategies to develop simple models of these complex soft matter systems. For more information, visit the Dutcher Lab webpage.

Lectures:

Monday, Wednesday, Friday; 13:30 – 14:20; MACN 118

Calendar Description:

Biological systems provide a rich range of examples of specialized chemical systems that are structured on the nanoscale. Nanofibres, microtubules, viruses, and ribosomes are examples of systems that can be studied from the perspective of nanoscience. Using these systems or developing artificial systems that mimic their functionality are important growth areas in nanoscience and will be explored in this course.

Prerequisites:

NANO*2100 Analysis of Nanomaterials

Recommended Textbook:

R. Phillips *et al*., **Physical Biology of the Cell**, 2nd Ed. (Garland, 2012)

References:

Some general book references are:

B. Alberts *et al*., **Molecular Biology of the Cell**, 4th Ed. (Garland, 2002)

J. Kuriyan *et al*., **The Molecules of Life** (Garland, 2012)

K.A. Dill & S. Bromberg, **Molecular Driving Forces**, 2nd Ed. (Garland, 2011)

A.Y. Grosberg & A.R. Khokhlov, **Giant Molecules**, 2nd Ed. (World Scientific, 2011)

C. Branden & J. Tooze, **Introduction to Protein Structure**, 2nd Ed. (Garland, 1999)

D. Boal, **Mechanics of the Cell** (Cambridge, 2002)

J. Israelachvili, **Intermolecular and Surface Forces**, 3rd Ed. (Academic, 2011)

R.A.L. Jones, **Soft Machines: Nanotechnology and Life** (Oxford, 2004)

C. Kumar (Ed.), **Biomimetic and Bioinspired Nanomaterials** (Wiley-VCH, 2010)

E. Gazit, **Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology** (Imperial College, 2007)

Course Topics:

- introduction to quantitative biology
    - power of physical approach to biological systems
- introduction to biomolecules and biological membranes
    - building blocks and interactions
- lipids and self-assembly of lipid structures
- macromolecules: polymers
    - random walks & diffusion
- macromolecules: proteins & DNA
    - building blocks and higher order structure
- self-assembly of macromolecules

    - copolymers, protein filaments, peptide-based self-assembly
- biological machines
    - bacterial flagella, myosin & kinesin walking, Brownian ratchet
- bionanocomposite materials
    - unique properties

In addition, the course lectures will be complemented by several guest lectures given by faculty members in physics and biology.

Course Learning Objectives:

This course will use a multidisciplinary approach to present new concepts and build on concepts covered in previous physics, chemistry and nanoscience courses. The objectives of this course are:

1) Understand the principles of the quantitative biology approach
    - Develop an appreciation of the experimental, theoretical and computational approaches that can be applied to biological systems

2) Understand the basic building blocks of biology and how they bind to form biological molecules
    - Expand knowledge of different types of structure within biological molecules

3) Understand different interactions between biological molecules and the principles underlying the self-assembly of aggregates of biological molecules and nanomaterials
    - Demonstrate knowledge of the key principles of self-assembly

4) Appreciate the diversity and complexity of self-assembled biological nanomaterials
    - Demonstrate knowledge of hierarchical structures and functional nanomachines

5) Expand scientific writing skills to develop effective communication
    - Develop ability to synthesize implications of key results of published scientific studies, and evaluate student writing by marking a NANO*1000 report

Evaluation:

Assessment	Weight
Assignments	30%
Directed Reading Assignments	15%
Review NANO*1000 Paper	5%
Midterm Test (Oct 26, 19:00-21:00)	20%
Final Examination (Dec 12, 14:30-16:30)	30%
Total	**100%**

The assignments and directed reading assignments are due at the beginning of class on the due date. Unless there are exceptional circumstances, marks will be deducted for lateness (10% per day). Marks will also be deducted for errors in English grammar and spelling in all work submitted for grading. Students must obtain a final grade of 50% to pass the course.

If you request academic consideration due to illness of a physical, psychological or emotional nature, or due to compassionate reasons, you may be required to provide suitable documentation (e.g., a medical certificate from a physician) at the discretion of the lecturer. See the undergraduate calendar for information on regulations and procedures for Academic Consideration.

CourseLink Page:

There is a NANO*4100 CourseLink page to allow you easy access to course-related material.

HELP!

Short questions can often be handled in the lecture room just before or after lectures. Hours will be announced when John is almost certain to be in his office for consultation with students. He will make every effort to answer emails in a timely manner.

Academic Misconduct:

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

See the Undergraduate Calendar for information on the Academic Misconduct Policy.

Collaboration Versus Copying:

Scientists often consult fellow scientists to discuss their research problems. Collaboration between scientists is often essential to perform world-class research. However, no ethical scientist would ever publish or claim the work of others as his or her own. Instead, joint publication or acknowledgements of the contributions of their collaborators is given.

The work that you submit for marking must be your own and not a copy of someone else's work. As a young scientist, you are encouraged to discuss with your fellow students as you learn the material and work on your assignments and presentations. However, plagiarism is a form of academic misconduct, and will not be tolerated. In your work that you submit for marking, you are encouraged to cite references and acknowledge discussions with others who have helped you to achieve an understanding of the material. This is good scientific practice.

Student Assessment:

The Department of Physics requires student assessment of all courses taught by the Department. These assessments provide essential feedback to faculty on their teaching by identifying both strengths and possible areas of improvement. In addition, annual student assessment of teaching provides part of the information used by the Department Tenure and Promotion Committee in evaluating the faculty member's contribution in the area of teaching.

The Department's teaching evaluation questionnaire invites student response both through numerically quantifiable data, and written student comments. In conformity with University of Guelph Faculty Policy, the Department Tenure and Promotions Committee only considers comments signed by students (choosing "I agree" in question 14). Your instructor will see all signed and unsigned comments after final grades are submitted. Written student comments may also be used in support of a nomination for internal and external teaching awards.

No information will be passed on to the instructor until after the final grades have been submitted.

Note:

John may be away several times during the semester for research purposes. He will try to arrange that enthusiastic and talented replacement lecturers give lectures at the regular times. Otherwise, makeup lectures will be arranged at times that are agreeable to the students.