MCB 529 *Glycobiology* Fall 2011

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Tues & Thurs 12:30 – 1:50 **3 credit hours**

Undergrads welcome (MCB 354 or 450 expected)

A cross-disciplinary course on the properties, synthesis, and functions of sugar-containing biomolecules (a.k.a. glycans) and their importance in biology, medicine, & biotechnology. *For microbiologists, cell biologists, biochemists, and chemists interested in careers in biomedical research, medicine, biotechnology, or the pharmceutical industry.* Here's why the field of Glycobiology is so important. The following aspects will be covered in this course.

"Glycan" is a catch-all term for monosaccharides, oligosaccharides, and polysaccharides, which can sometimes be attached to proteins or lipids. ***Sugar-containing molecules are a fundamental feature of living cells.***

All cells are covered with a dense and complex array of glycans. Glycans can be structural polymers in the cell walls of microbes or plants, but they also mediate recognition events in animal development, in inflammation, and in immunity. Blood groups, for example, are defined by specific glycan structures, and specific protein-carbohydrate interactions allow recruitment of lymphocytes to sites of injury.

Inside eukaryotic cells, glycans linked to proteins *enhance protein folding and stability*, and one type of sugar modification is a regulatory alternative to protein phosphorylation.

Cell surface glycans are synthesized in pathways that follow a *conserved theme* in which assembly starts at the cytoplasmic face of a membrane, and finishes extracytoplasmically or extracellularly, and involves carrier lipids. Some polysaccharides are made by plasma membrane enzymes, for example, cellulose and chitin, the two most abundant biological molecules on the planet.

Glycans are vitally important in medicine. Congenital defects in protein glycosylation lead to a range of *developmental defects*. Surface glycan structures are *altered in cancer* cells and serve as markers for tumors. Because a cell wall is essential for bacteria and fungi, glycan biosynthetic pathways for microbial cell wall biogenesis present great *targets for antibiotics*. Cell surface glycans of parasites (e.g. malaria) are potential vaccines.

Glycans are key signalling molecules in the establishment of plant-microbe symbioses. These include the agriculturally important association between N_2-fixing bacteria and the roots of leguminous plants, and mycorrhiza, the ecologically important symbiosis between soil fungi and plant roots.

Glycans are important in biotechnology. Heterologous expression of proteins must take host-specific glycosylation into account. There is much interest in use of high-cellulose plants, and enzymes that degrade plant cell wall polysaccharides, to generate biofuels.

Chemical biologists are making exciting advances in the synthesis of complex glycans, allowing protein-carbohydrate interactions to be probed in arrays, as well as development of carbohydrate vaccines.

This course integrates biochemistry, microbiology, cell and developmental biology, and chemical biology to show how glycans are critical in *fundamental cellular biochemistry, organismal development, immunity & inflammation, medicine, development of antimicrobial drugs & vaccines*, and *biotechnology*. You'll also learn about analytical techniques in glycobiology and about experimental strategies to explore glycan function.