7.346 Engineering Immune Responses through Biomaterial Design

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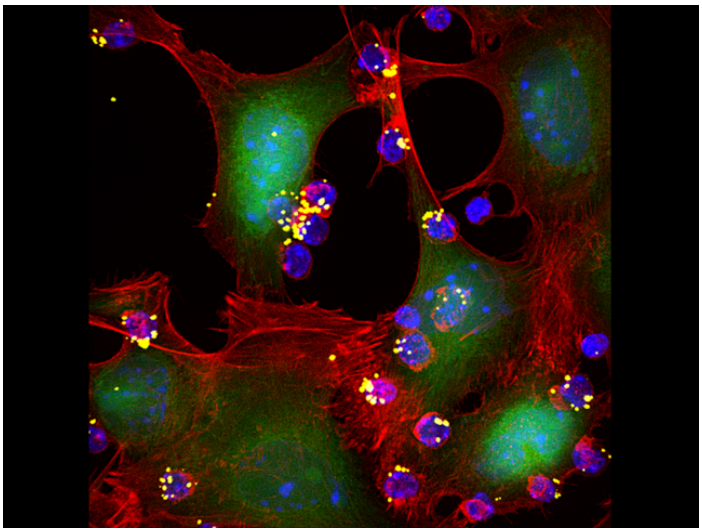
Spring 2015. Thursdays, 11 am – 1 pm. (Class time is flexible.) Room 68-150.

Vaccines are combinations of antigens (substances that stimulates an adaptive immune response) and adjuvants (substances that accelerate, prolong or enhance an antigen-specific immune response) that can elicit a robust, long-lasting immune response. Vaccines have been used to eradicate diseases like small pox and polio. Other diseases, including HIV, cancer, and various autoimmune disorders, have not been able to be effectively treated using vaccines. In this course we will focus on bioengineering approaches to better understand the mechanisms of immune responses and to create novel therapeutics. Based upon the recent primary research literature, we will discuss approaches to understand and enhance the interactions of synthetic biomaterials with the immune system to program immune cells to perform specific tasks, such as the production of HIV-neutralizing antibodies by B cells or the elimination of cancer cells by enhancing the activity of cytotoxic T cells. Specifically, we will discuss parameters that affect the behaviors of different materials, such as particle size, shape, and chemical structure, in the contexts of vaccines. We will also consider other immunotherapies, such as the engineering and delivery of anti-tumor antigen specific T-cells.



This image portrays how tumor specific T-cells (blue) bound to drug loaded nanoparticles (yellow) can recognize tumor cells (green) and unload their nanoparticle cargo. Image by Sudha Kumari/Yiran Zheng (Irvine Laboratory).