Week 11 Lecture 0

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1 Administrative drivel

- Second submission for the term paper due at 11:59pm today!
- The review sheet covers more than we will get to, but we'll only cover through wednesday's lecture.
- Lecture images are posted as well.

2 Defence and repair – immune system

- Last time – the B-cell system – some review
  - Identifies specific pathogens for distruction
  - then, phagocytes come and goble the pathogens that are marked
  - It can take several weeks to go from B-cell activation, to plasma cell generation by cloning, to memory B-cells.
  - but, memory cells can complete this process before you even notice
  - having memory cells == immunity
- Specific Immunity – extracellular
  - pathogen enters the body
  - Pathogen have uniqe surface protiens == 'antigens
  - B-cells have receptor surface proteins == 'antibodies'
  - B-cells mark pathogens for destruction by mathing their antibodies to the pathogens' antigens
  - B-cells shed antibodies into the blood
  - antibodies bindd to antigens
  - bound antigens clump together and are taken out by phagocytes
- clicker Q: What can't B-cells fight off intracellular infections? intracellular pathogens are inside your body's cells, where their antigens are hidden from B-cells

2.0.1 Intracellular infection

- Pathogen enters the body
- pathogen endocytosed by "antigen-presenting cells" – APCs
  - APCs are T-cells
  - dendritic cell – has lots of arms
- APC breaks apart pathogen to find antigens by digesting it

- APC presents antigens to "cytoxic T cells" teaching them how to recognize infected cells
  - cytoxic T cells can bind to the antigen being presented
  - If they can bind, they are activated
- Cytotoxic T cells multiply, then migrate to attack infected body cells
  - this means they're killing your own cells.
- after the infection is reduced, some of the T cells stick around and become memory T cells
  - Some are good for a lifetime, and some are good for a few years
  - If they see the antigen again, they will kill those cells

2.0.2 How does your body match a novel antigen?

- If an antigen is like a lock, you need a key of exactuly the right shape (antibody)
- Make many different keys, and keep trying until one works
- antibodies are made of
  - 2 heavy chains (larger) and 2 light chains (smaller)
  - There are many types of each kind of chain, and combining different ones makes an antibody that can bind to a different antigen.
  - This allows the body to generate millions of different antibodies (2-3 million)
  - They are aranged very slopy
  - Actively promote mutations in the genes that code for these proteins
    - randomly produce new versions of chains
  - this gives us more than 2 billion possible antibodies
- Once you find the right key(antibody), create effector cells that mark the pathogens for destruction, then some of the effectors are saved as memory cells for rapid reactivaation without having to find the right key (antibody)
- Acquired – secondary response
  - First infection starts small, grows, and your response grows along with it
    - This takes 2-3 weeks before B-cell population out produces the pathogen population growth
  - On second exposure, the infection starts small, but the B-cell population spikes rapidly
    - This is the secondary immune response
    - this allows us to not spend most of our lives sick...
    - If you have this response, we say you're immune
- We can trick the system into making the antibody with vaccine
  - The antigen part of the pathogen, or a killed version of the pathogen is used to induce production of memory cells
  - So, if the person is exposed to the real pathogen, it already has the memory cells/antibodies to fight the infection
  - this allows you to mount a secondary response upon first exposure
- Vaccination has been around since the late 1700s
  - Edward Jenner – 1796 – figured out a sequence of things to do to give immunity to small pox!

  - He extrapolated that Milk Maides didn't get small pox from folklore about them being pretty! This was because cows got cowpox, a closely related pathogen, which exposed the maids to similar antigens to those on small pox
  - So, Jenner too people and exposed them to cow pox by rubbing puss into wounds on a person, and they would gain immunity

- How long can immunity last?
  - Smallpox memory B-cells last for ¿50 years
  - Tetanus booster vaccinations recommeded every 10 years
  - Professor is unsure why some fade faster than others...

2.0.3 Influenza

- Why do we need a flu shot every year?
  - There are many strains of flu, and it mutates rapidly
  - Vaccinations cover the strain that is predicted to come the following year
  - We loose 20-30k people per year, but during the COVID pandemic we lost about 10k last year