Adaptive immunity

- **Molecular binding: a key to biology**
- **Immune system themes**
  - **Cooperation**
  - **Recognition**
  - **Proliferation**
  - **Actions**
- **Immunology puzzle: Binding partners**
  - **B-cells and antibodies**
  - **T-cells: helpers and killers**
- **The importance of memory**

Immune system themes

- **Cooperation between *different cells* of the immune system**
- **Recognition of *specific pieces* of microbes (through binding)**
- **Proliferation (multiplication) of *individual cells* to fight a *specific* microbe**
- **Actions that *individual cells* use to fight a *specific* microbe**

Comparison of adaptive immune cells

	B-cells	Helper T-cells	Cytotoxic T-cells
Origin (Which organ?)			
Key cell surface molecule			
How are antigens recognized?			
How does the cell help fight microbes?			

Recognition of foreign molecules by the adaptive immune system: An immunology puzzle

The adaptive immune system in mammals is an amazingly intricate and elegant system that allows the body not only to recognize *very specific* foreign molecules, but also to *remember* the molecules once they have been "seen" before. The ability of the adaptive immune system to work relies on B-cells and T-cells *binding to foreign molecules* (called "antigens") and becoming *activated* to perform their specific jobs.

Your mission: To figure out what determines whether a T- or B- cell can bind to a foreign molecule.

The system: For this puzzle, I have simplified the human body--from many trillion cells down to13 different cells, some of which are immune cells (B-cells, T-cells, phagocytes), some of which are other cells that have been infected by viruses. The remaining puzzle pieces are two viruses (influenza and HIV), a bacterium (*E. coli*), and three antibodies (proteins that are made by B-cells and can be released by the B-cell into the blood and lymph).

Questions to address (for your assigned adaptive immune cell type):

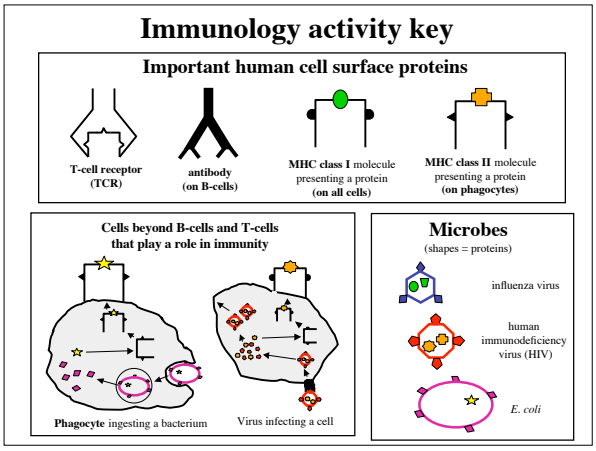
1. What **molecule(s)** does the T- or B-cell **bind to**?

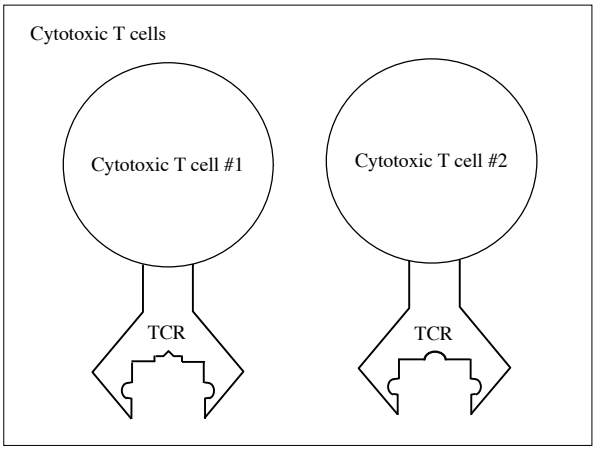
2. Where are these target molecules (inside a cell, outside a cell, on the surface of a cell etc.) when they are recognized by the T- or B-cell?

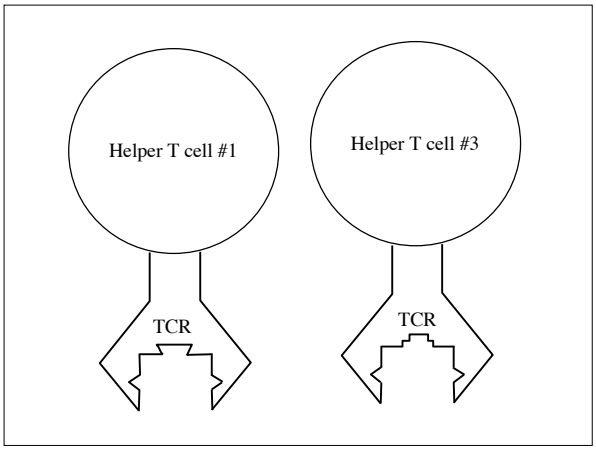
3. Where else are the **microbial molecules** found (when they are not binding to T- or B-cells)?

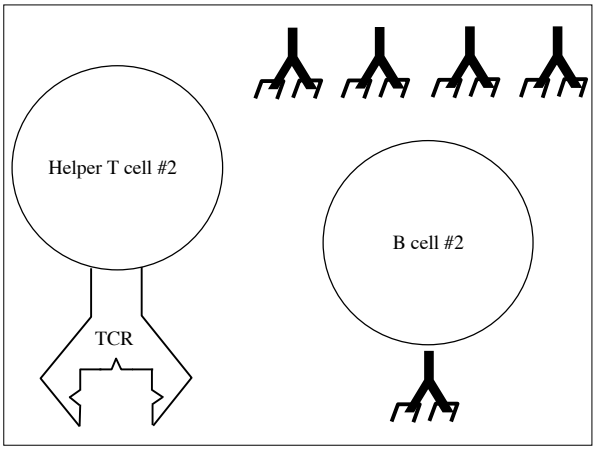
4. What molecule on the **T- or B-cell** allows binding to the target molecule?

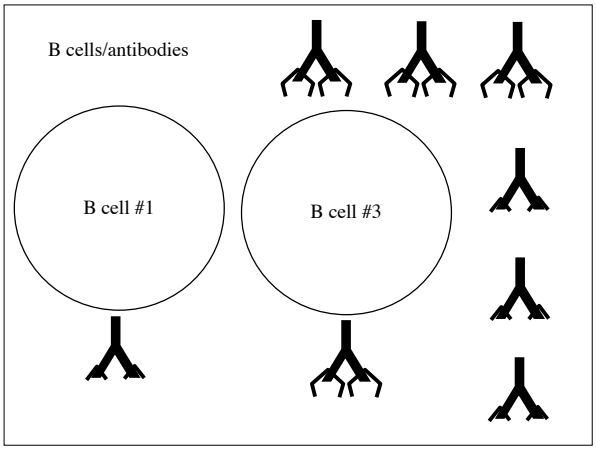
After all the groups have solved their part of the puzzle, we will put all the pieces together and talk about how activation of B- and T-cells helps the body fight microbial infection.

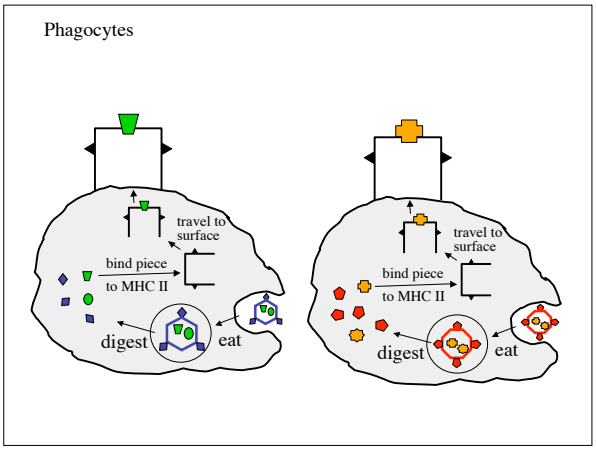


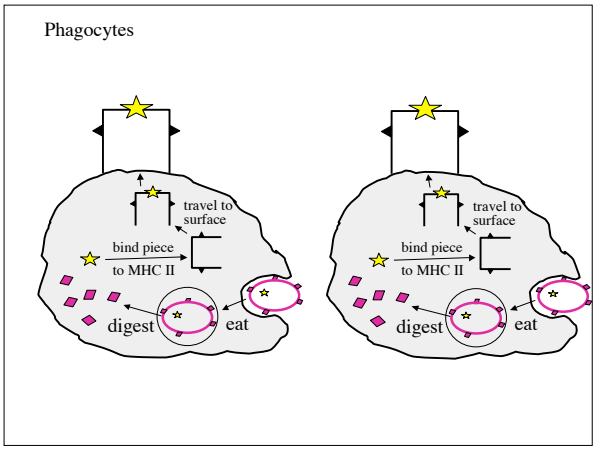





Helper T cell #2
TCR
B cell #2


B cells/antibodies
B cell #1
B cell #3


Phagocytes
travel to surface
bind piece to MHC II
digest
eat
travel to surface
bind piece to MHC II
digest
eat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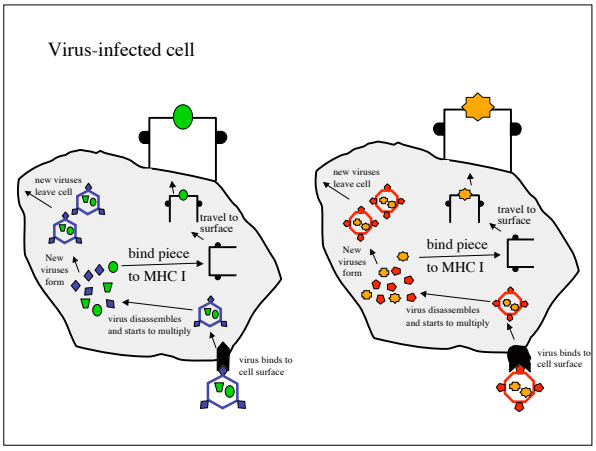
Virus-infected cell
new viruses leave cell
travel to surface
bind piece to MHC I
New viruses form
virus disassembles and starts to multiply
virus binds to cell surface
new viruses leave cell
travel to surface
bind piece to MHC I
New viruses form
virus disassembles and starts to multiply
virus binds to cell surface