Ys and Antibodies

How antibodies help us stay healthy.

Image credit: Antibody by Fredrik Edfors, SE
Let's get to know each other:

Introductions
What is an Antibody?

- Antibodies are a part of the immune system that bind to foreign material like viruses and bacteria.
- When an antibody binds to a material, it signals white blood cells to attack and breakdown the material.
- When you are sick, your body is creating lots of different antibodies to try and find one that recognizes the bacteria or virus making you sick.
- After you have fought off an infection, memory B cells “remember” the invader and quickly produce the right antibodies if it comes across the invader again.
Label the “Ys”: Parts of an antibody

1. Label the light chain of the antibody with the letter “L”
2. Label the heavy chain of the antibody with the letter “H”
3. Draw rectangles around the variable regions on this antibody.
4. Circle the constant region(s) on this antibody.
5. Draw an arrow to the region that may bind to a specific epitope.
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The Virus and its Antigens: Recognizing potential invaders.

1. Where are the potential epitopes in the diagram above?

2. How many different types of epitopes do you see?

3. What is the relationship between epitopes, antigens, and antibodies?
Hands-on Activity!

1. Does antibody 1 recognize the influenza virus? If so, which epitope does it recognize?
   a. Find out by pushing the antibody’s binding site on different virus epitopes and seeing if they stick together. Be sure to repeat this for every epitope on the virus!

2. Does antibody 2 recognize the influenza virus. If so, which epitope does it recognize?

3. Now check if antibody 1 can recognize the coronavirus. If it does, which epitope does it recognize?

4. Finally, does antibody 2 recognize the coronavirus? If so, which epitope does it recognize?
Hands on Activity
How many different viral spike types (epitopes) can you identify?

A. 1
B. 2
C. 3
D. 4
The 3D antibodies in the image are composed of...

A. Blue heavy chains and white light chains
B. Blue light chains and white heavy chains
Which epitope does this combination of heavy chain 1 and light chain 1 bind?

A. A  
B. B  
C. C  
D. D
What epitope does this combination of heavy chain 2 and light chain 2 bind?

A. A
B. B
C. C
D. D
E. None of these
Antibody 2
Now create new antibodies by combining heavy chain 1 with light chain 2, and heavy chain 2 with light chain 1. Do the new antibodies bind to the epitopes?

A. They bind better  
B. They bind more weakly  
C. There is no difference
Do either of the original light/heavy chain combinations bind antigens on the coronavirus?

A. Yes, one binds  
B. Yes, both bind  
C. No, neither bind
Discussion Questions

1. Do all antibodies share the same binding region?
2. When an antibody binds to a virus, is it able to recognize every epitope presented by the virus?
3. Why is binding of an antibody to an epitope important in the immune response?
4. What do vaccines have to do with the production of antibodies?
Vaccines and Antibodies

- Your body is unable to recognize pathogens it has not encountered before.
- A vaccine exposes your body to a harmless version of the pathogen so your body is able to produce antibodies that recognize it.
- If you ever come across the actual pathogen, you now already have antibodies to fight it off.
How do antibodies protect us?

1. Virus binds to receptors on cell surface
2. Receptor-mediated endocytosis of virus
3. Fusion of virus with cell and entry of viral genome

Antibody blocks binding to virus receptor
An Actual Virus and Antibody

These are the actual structures of a plant virus and a human antibody. It is not easy to identify the epitopes or determine if an antibody will bind to them!
What else do you think antibodies can do?
Thank you for your time and questions!

Don’t hesitate to contact us with questions!
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Images created with BioRender.com