Antibody and Antigen	Grades 9 and 10

Lesson Plan

Description

Antibodies are made by lymphocytes called B cells. They are essentially the receptors of B cells. Antibodies are made to fit the antigen of a particular pathogen. The next time you are infected with the same pathogen, your memory B cells will remember how to make the antibodies to fight the pathogen quickly.

Learning Outcomes

Students will learn that antibodies are proteins with a particular shape,
Students will learn that our B cells can make antibodies for pathogens we have never encountered.
Student will learn that antibodies can change and adapt to pathogen antigens to get a better “fit”.

Materials

Go to https://www.exploratorium.edu/snacks/antibody-attack to print copies of the antigens and antibodies.
Five sheets of paper, each in a different colour
Five pieces of white paper
Black markers (for tracing)
Scissors
Plastic grocery bag.
Open space- e.g., large table or the floor

Action

Set up:

1. Cut out five antigen templates from your printouts.
2. Trace antigen shapes onto coloured paper and cut along the traced lines to make two of each antigen using one color of paper per antigen. (Two or more copies should fit on one sheet of paper.)
3. When you’re done, you should have two blue copies of Antigen A, two yellow copies of Antigen B, two pink copies of Antigen C, and so on. You can use any colours you want, except white.
4. You’ll need the heavy white paper for your antibodies.
5. Cut out the five antibody templates from your printouts.

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6. By tracing and cutting, make one copy of each antibody using your sheets of heavy white paper.

Activity:

1. Place all the antigens and antibodies on a flat surface, such as a table or the floor (this surface represents the body). Move all the antibodies to one side and all the antigens to the other.
2. Remember, antigens are proteins found on the surface of pathogens, such as viruses, bacteria, and other foreign invaders to the body. What do you notice about the antigens? Are there any similarities among them? Any differences?
3. Antibodies are proteins produced by B cells, which are specialized cells produced by your immune system. Antibodies are like the receptors of B cells. What do you notice about the antibodies? Are there any similarities among them? Any differences?
4. Slide the antibodies across the surface and connect them to their matching antigens. Are the matches always perfect? Can an antibody connect to more than one antigen? Can an antibody connect to more than one type of antigen? What happens as a result of the antigens connecting to the antibodies?
5. Attach as many antibodies to antigens as you can and notice that eventually all the antigens become trapped in interconnected groups.
6. Phagocytes (macrophages, neutrophils and dendritic (antigen presenting cells)) are attracted to the site of infection because infected and dying cells are releasing chemical signals. Phagocytes are “eating” pathogens through a process called phagocytosis. When the adaptive immune system is engaged and B cells create antibodies, phagocytes will eat the pathogens that are surrounded by antibodies.
7. Use the plastic grocery bag as a phagocyte! Use the bag to engulf, ingest, and eliminate these large globs of material. How might this process help the body fight an infection?

Consolidation/Extension

This activity shows how the adaptive immune system works to eliminate pathogens from an infection. The adaptive immune system kicks in if an infection persists and cannot be defeated by the phagocytes on their own.

The great part about the adaptive immune system is that it results in the creation of memory cells. These immune cells will recognize the returning pathogen quickly and fight an infection faster the next time around. This can result in less illness, or even no symptoms of infection at all.

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Vaccines take advantage of this feature of our immune system by exposing our bodies to mimic pathogens that will cause our immune system to create and immune response without the consequences of getting infected by the pathogen.

Have students think of some diseases we have managed to control quite effectively with vaccines. Ask students why they think some vaccines might not be as effective at creating a sterilizing outcome (reduce your chance of infection through vaccination) as other vaccines. What might a pathogen do to be more successful at creating subsequent infections?

Additional Resources

Adapted from: Antibody Attack by the Exploratorium
https://www.exploratorium.edu/snacks/antibody-attack
Paper models of antibodies: https://pdb101.rcsb.org/learn/paper-models/antibody

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