Elementary

LESSON 2

Hilleman & Vaccines

Lesson 2

How Does Our Body Fight Diseases?

Hilleman & Vaccines

LESSON INSTRUCTIONS

Lesson 2: How Does Our Body Fight Diseases?

ESSENTIAL QUESTION

What can we do to help our bodies stay healthy?

OVERVIEW & PURPOSE

Students will work together to complete a KWL (Know, Want to Know, Learned) chart on vaccines and diseases. They will watch videos of how the immune system and vaccines work, complete a vocabulary word matching activity, and play a hands-on Antibody Attack Activity demonstrating how antibodies attack invaders. The lesson will conclude with the opportunity to debate whether good hygiene alone is enough to protect our bodies and demonstrate what they've learned through simple illustrations and cartoons.

MONTANA EDUCATION STANDARDS

3-LS1-1. Developing and Using Models

K-2-ETS-1. Students can define the problem, note his observations, and explain his solutions.

CCSS.ELA-LITERACY.W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons.

CCSS.ELA-LITERACY.RI.3.4 Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area.

OBJECTIVES

Students will

1. Describe that most children will have received vaccinations and will explain that these protect from disease.
2. Be able to describe how the immune system fights diseases with antibodies and antigens.
3. Be able to describe how vaccines work.
4. Describe different types of pathogens.

LESSON INSTRUCTIONS
Lesson 2: How Does Our Body Fight Diseases?

MATERIALS

- Supplies for "Antibody Attack" activity: (pages 88-93)
- "What I've Learned" worksheet assessment (page 95)

VERIFICATION

Ask these questions at the end of the lesson to check for student understanding:

1. What is a pathogen?
2. How do diseases spread?
3. How does the immune system work?
4. How do vaccines work?

ACTIVITY INSTRUCTIONS
Lesson 2: How Does Our Body Fight Diseases?

ENGAGEMENT

Use the following discussion template to introduce the lesson:
Ask students if they remember getting their first "shot". Let a few students share their experiences. Ask if anyone knows what "immunization" means. Why do you think we immunize babies at such a young age? Complete the Know, Want to Know, Learn chart on vaccines and diseases. Watch the video of "How the immune system works!" (7:25) https://youtu.be/24IYt5Z3eC4

EXPLORATION

Next watch the video "The Immune System" (3:37) https://youtu.be/_Ypw3s0pNNU

Then go to this video on YouTube that shows how "A Virus Attacks a Cell." (1:42) https://youtu.be/jkNxmTrrZSk

Finally, show this video about "How Vaccines Work" (4:35) https://youtu.be/rb7TVW77ZCs

Note: If you are unable to access YouTube in your classroom, you can embed the videos in a slideshow prior to class or visit https://vaccinemakers.org/resources/videos-animations for other resources

ACTIVITY INSTRUCTIONS
Lesson 2: How Does Our Body Fight Diseases?

EXPLANATION

After watching the videos, lead a short class discussion using the following dialogue:

Ask students: What is a disease?
A disease is a problem in your body that makes you feel ill or sick. Some diseases only last a few days, but other diseases can last for a lifetime. Some diseases give you mild symptoms like fever or coughing. Some diseases can be much more serious and even deadly.

Explain: There are 4 different types of diseases: (Give examples of each)

1.Genetic diseases are diseases that you are born with. They come from a problem or change in your genes as you develop in the womb. (Examples - Cystic fibrosis and Huntington disease)

2. Deficiency diseases are illnesses that you can get if you don't get the right amount of vitamins and minerals in your diet. (Examples - Scurvy and Rickets)

3. Physiological diseases happen when the body goes wrong like cancer or heart disease. (Examples - Asthma and Diabetes)

4. The last disease is infectious disease. These happen when tiny living cells called organisms get inside the body. Any organism which causes a disease is called a pathogen. Infectious disease can be passed from person to person. (Examples - Chickenpox, Influenza and HIV/AIDS)

Finish by saying: There are several ways to stop infections. Washing your hands and vaccinations are two of the best. Vaccination is a way of making people immune to a particular disease. There are four ways vaccinations work, but the most common way involves putting a very weak form of pathogen into the body. This weak pathogen doesn't make you ill, but it does make your body fight it with antibodies. These antibodies are remembered by your body, so that if you get any of the same pathogens again, you won't get ill, because your body will remember how to fight the disease.

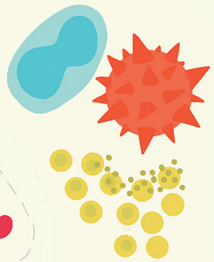
Now have students read and fill out the worksheet for "How Vaccines Work" (pages 86-87)

ACTIVITY INSTRUCTIONS

Lesson 2: How Does Our Body Fight Diseases?

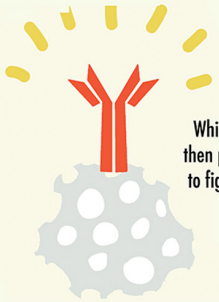
How Vaccines Work

There are almost 400 trillion bacteria and viruses in and on a human body, but most will not cause disease.

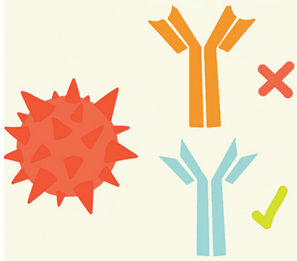


Some bacteria and viruses will cause illness if they get past the body's barriers and multiply.

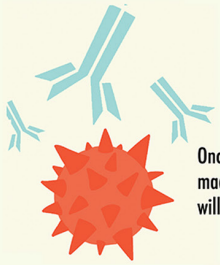
Once a disease causing organism enters the body, it will do its best to replicate quickly.



White blood cells will then produce antibodies to fight off the virus or bacteria.



The antibody has to be the right shape to fight the disease. Producing the right antibody can take several days.



Once the correct antibody is made, the white blood cell will make many more.

The antibody can then deactivate the virus or bacteria.

The cells that make the antibodies can last for years and are referred to as "memory" cells that can rapidly respond if the infectious disease returns.

Vaccines help fight disease by teaching your immune system how to make the right kind of antibodies for certain kinds of germs and the diseases they cause.

mRNA Vaccine

Make proteins that trigger an immune response.

The Pfizer and Moderna COVID-19 vaccines are mRNA vaccines.

Subunit Vaccine

Use specific pieces of the germ, like its protein or sugar, and give a strong, targeted response.

These vaccines protect against HPV.

Inactivated Vaccine

Use the killed version of the germ that causes a disease. Some inactivated vaccines need booster shots in order to provide ongoing immunity.

The flu shot is an inactivated vaccine.

Live-attenuated Vaccine

Use a weakened version of the germ that causes a disease. Their capacity to cause disease has been eliminated (attenuated).

These vaccines protect against smallpox and measles, mumps & rubella.

Graphics by Claire Jorgensen *Words by Sabre Moore*

Name _____

HOW VACCINES WORK QUESTIONS

1.What type of cell produces antibodies?

2. How long does it take to produce the right antibodies?

3. What are “memory” cells?

4. How do vaccines help fight disease?

5. Give an example of an mRNA vaccine:

ANTIBODY ATTACK

ELABORATION

This activity will help elaborate how antibodies launch attacks on invaders. Students will explore how their immune system seeks out and disables pathogens and prepares their body for future attacks.

MATERIALS

- One printout of tabletop-sized Antigen and Antibody templates (for individuals and small groups) or full-sized templates (for a larger group) (pages 92-93)
- Five sheets of cardstock or construction paper, each in a different color (so one sheet of green paper, one of yellow, one of blue, one of orange, and one of purple, for instance)
- Five pieces of white cardstock or construction paper (or two pieces, if using the tabletop templates)
- Black markers (for tracing)
- Scissors
- Plastic garbage bag
- An open space to work, such as a large table or on the floor

INSTRUCTIONS

1. Cut out the five antigen templates from your printouts.

2.Trace cutout shapes onto colored 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 colored cardstock or construction paper.) When you're done, you should have two green copies of Antigen A, for instance, two yellow copies of Antigen B, two blue copies of Antigen C, and so on. You can use any colors you want, except white. You'll need the heavy white paper for your antibodies.

3.Cut out the five antibody templates from your printouts.

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

5. Place all the antigens and antibodies on a flat surface, such as a table or the floor (this surface represents the body). Move all of the antibodies to one side and all of the antigens to the other.

6. 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?
Attach as many antibodies to antigens as you can, and notice that eventually all the antigens become trapped in interconnected groups.

VOCABULARY

Antigens (represented by the colored shapes) 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?

Antibodies (represented by the white shapes) are proteins produced by B cells, which are specialized cells produced by your immune system. What do you notice about the antibodies? Are there any similarities among them? Any differences?

Phagocytes—another type of cell in your immune system—are attracted to connected collections of antibodies and antigens like these, and recognize them as trash. Your plastic garbage bag is your phagocyte! Have the bag engulf, ingest (gobble up), and eliminate these large globs of material. How might this process help the body fight an infection?

Please Note: This activity is adapted from Exploratorium "science snacks: Antibody Attack!" Available at: https://www.exploratorium.edu/snacks/antibody-attack

EXPLANATION

This activity is a simple model of the adaptive immune response, one part of the human body's immune system response. While this is not the first step in a real immune response, it is an important one that is unique to humans and higher vertebrates, and allows for the body to target specific pathogens and remember them in preparation for future contact.

Pathogens can invade your body through breaks in the skin, or through mucous membranes in your eyes, nose, and mouth, creating internal infections. While bacteria often grow in the fluids between your cells, and can reproduce and spread through the body via the bloodstream, viruses have a different strategy. Viruses cannot reproduce on their own, so they insert their genetic material into your cells and use them as virus-making factories. The newly copied viruses then exit the cells and spread throughout the body.

In response, the body's immune system launches a cascade of complex processes that end up with the antigen from the outside invader binding with a matching antibody. This joining takes place in the lymph nodes, on the surface of a specialized immune cell called a B cell. Because there are only a few B cells with antibodies that match any given antigen, the first contact with a specific antigen initiates a response that might take several days to become effective.

Once the match takes place, the B cells divide rapidly. Some become antibody-making factories called plasma cells, and some become memory cells, which retain the "memory" of that particular antigen for the future.

Plasma cells produce and release millions of antibodies into the bloodstream and lymphatic system. Those antibodies seek out and bind to specific antigens, disarming them, and stopping further spread of the pathogen. As you may have noticed in the activity, the fit isn't always perfect, but in the body, it continues to improve as the B cells make more and more antibodies.

Because the unique Y-shape of the antibody creates two binding sites for antigens, multiple antigens and

antibodies can clump together, creating globs of cells called agglutinations. These agglutinations attract phagocytes that find, ingest, and digest them, eliminating the dangerous pathogen and infected cells from the body. This process of antibody production and "cleaning"—represented in the activity by the plastic bag "gobbling up" the globs of material—continues for a few days until the pathogen is removed.

This activity matches just five kinds of antibodies and five kinds of antigens. In reality, there are millions of different kinds of each. Animals with adaptive immune responses have evolved the ability to not only target specific pathogens, but also to create memory cells that remember the pathogens they've been exposed to. When a familiar pathogen reenters the body, the immune system is prepared, the antibody launch is rapid and profuse, and the pathogen is often quickly eradicated. We call this "having immunity."

TIP

You can do this activity either in small groups using the tabletop templates as explained above, or with the whole class using the full-sized templates. To do the activity as a class, divide students into "antibodies" and "antigens." Distribute cutouts so that each "antibody" student has one antibody and each "antigen" student has two antigens. Have the antigen and antibody groups move to opposite sides of the room. Have the antigen group hold out their arms (like pathogens with antigens on their "surface"). Then have the students representing antibodies move across the room and find their corresponding antigens. When all the matches have been made, you can act as the phagocyte, using the trash bag to clear away the clumps of antibodies and pathogens until the "body" (the classroom space) is clear of any simulated pathogens.

As you complete this activity with students, consider what additional information they may need. Also, consider at which times you might have students assess whether aspects of this simulation accurately model the immune response. How might students change the model to make it more accurate? Where are the holes in the model that are hardest to fix?

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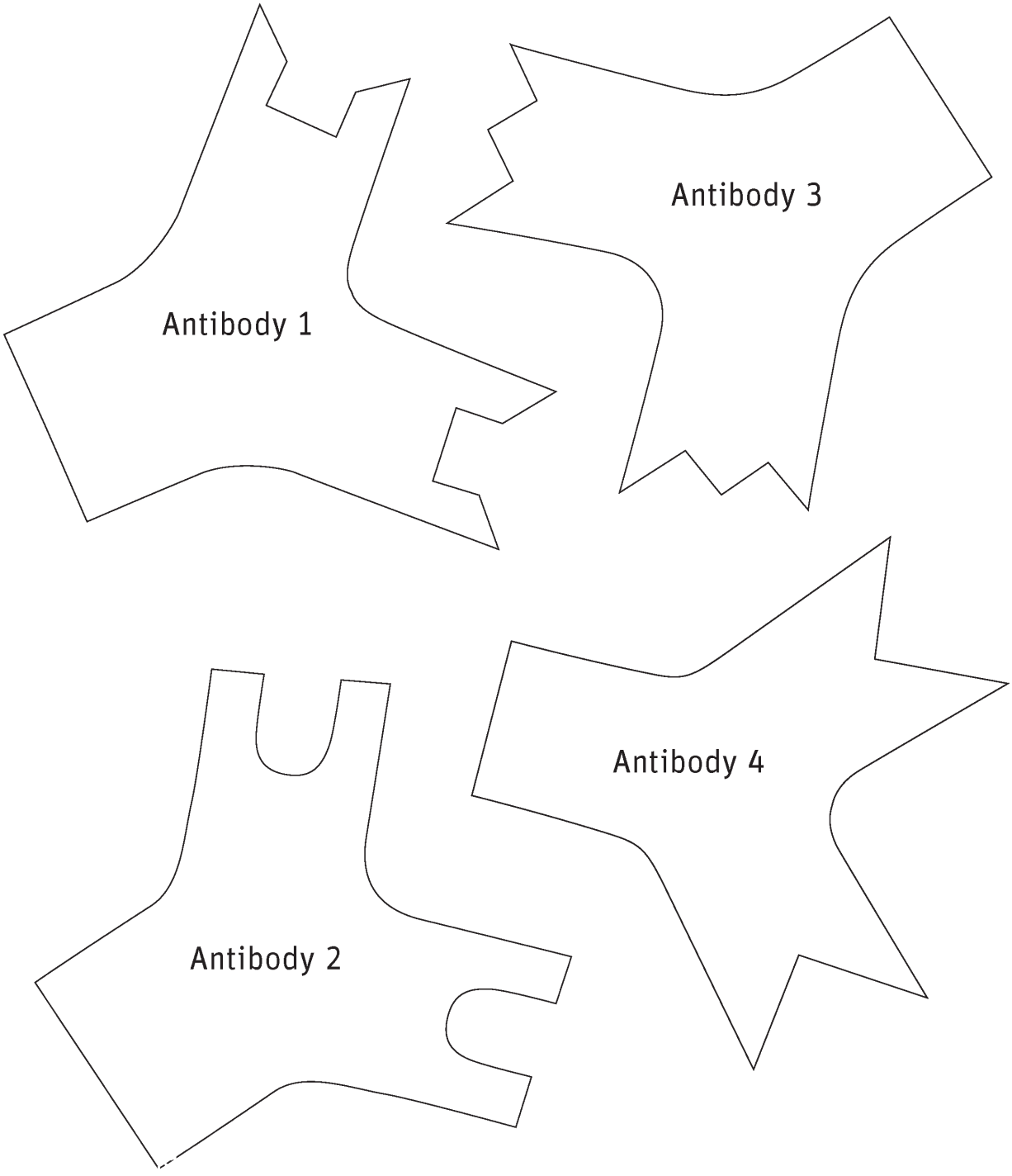
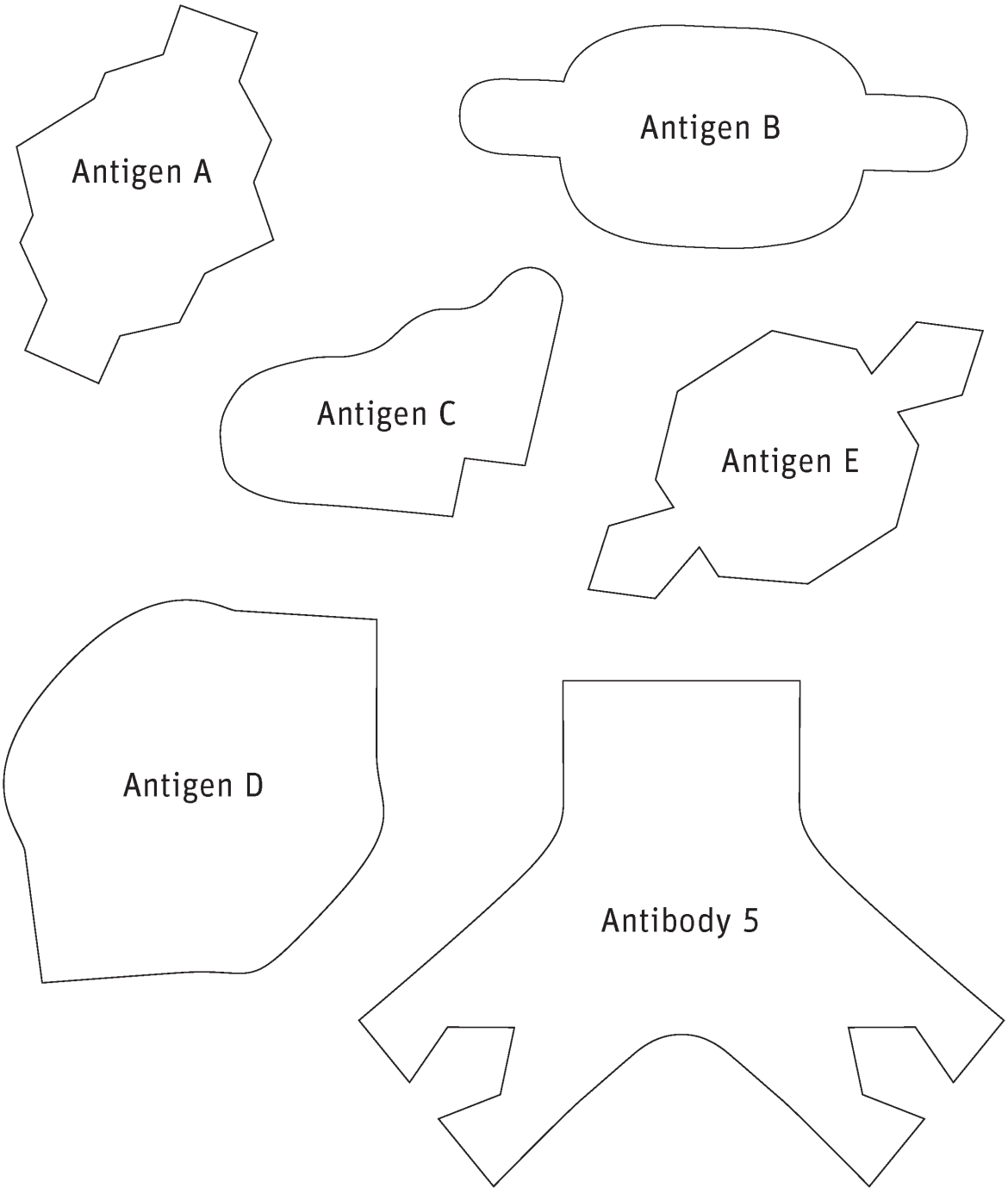


www.exploratorium.edu/snacks/antibody-attack



www.exploratorium.edu/snacks/antibody-attack

EVALUATION

Steps to check for student understanding:

1. Use the following prompt to guide a discussion reviewing the lesson concepts about hygiene.

"It's easy to avoid germs like viruses and bad bacteria - just make sure you wash your hands!"

- Do you agree?

2. Have students complete the assessment "What I've Learned". (page 95)

What I've Learned

Illustrate and write a few words about three ways infectious disease can spread.

Finish the cartoon to show how vaccines help our immune system fight infectious diseases, or draw your own cartoon on the back of this paper. Add characters to represent antibodies and germs.