Activity Summary: **Energize!**
Students will discover their relationship between metabolism and the energy we get from food, by growing yeast cultures in pop bottles with varying amounts of sugar. Students will also be introduced to the various kinds of common sugars and the importance of eating healthily.
**Time** 20-30 minutes

Activity Summary: **A perfect fit!**
Students will explore the role of shape-matching in every process of the immune system using salt-dough clay.
**Time** 30-40 minutes

Activity Summary: **You Make Me Sick!**
In this immunology board game, students will gain understanding about the immune system, basic transmission and common diseases.
**Time** 30-40 minutes

Full educational standards available at www.sepa.duq.edu/education
Dear Educator,

This workbook contains 3 activities to help your students learn about how the immune system fights disease and keeps us healthy. The first activity, Energized!, allows your students to explore how the food we eat provides energy for us to live. The second activity, A Perfect Fit!, uses salt-dough to demonstrate how our white blood cells recognize germs using 3D shapes. The third activity, You Make Me Sick!, is a board game that allows your students to fight disease with their knowledge of the immune system.

The Immune System

Our body’s immune system protects us from germs like viruses, bacteria, fungal infections and parasites. Our immune system is made up of special organs, vessels and many different types of unique cells that each play a very important role in keeping us healthy. We call the cells of the immune system white blood cells. There are four major types of white blood cells: T cells, B cells, Neutrophils and Macrophage.

Macrophage (mack-row-fage; from the Latin macro = big, phage = eat) are white blood cells that eat germs that have been covered by antibodies. Their job is to patrol the body looking for germs. When they find an infection, they send a signal to our T cells, and our T cells send the other white blood cells to the infection.

Neutrophils (new-tro-fills) are the white blood cells that are the “first responders” to infections. We have more neutrophils than any other type of white blood cell.

T cells are the most important white blood cell; they coordinate the activities of all of the other white blood cells and are essential for fighting disease. There are two major types of T cells: Helper T cells (T_H) and Killer T cells (T_K). Helper T cells send signals that activate the rest of your immune system to fight a germ. Killer T cells patrol the body and eliminate infected cells.

B cells also play an important role in protecting our bodies; they produce and release special proteins called antibodies. Antibodies stick to the surface of germs in our bodies, thus disabling them and also making them a target for another type of cell called macrophage. Each B cell and its antibodies can only recognize one kind of germ. Antibodies will only stick to germs, except in rare cases of autoimmune diseases where the antibodies mistake our own healthy cells for invaders.
**The Immune System**

**What DOES IT DO?**

**Your immune system remembers**! “Memory” T and B cells can remember all the germs they’ve found... for your whole life! This way, if that germ comes back your body can get rid of it very quickly! This is why you can only get sick from a disease one time (like Chicken Pox). You might be thinking, “But I’ve had lots of colds!” The “common cold” is actually caused by many different types of viruses that all cause the same symptoms, which is why you can “catch a cold” more than once. Because there are so many types of viruses that cause the common cold, there is no vaccine for the common cold.

Vaccines work by showing your body what a single germ looks like – like a “Most Wanted” sign. They help your immune system learn what a particular germ looks like, so it doesn’t make you sick. The vaccine helps your B cells produce antibodies against that germ and become Memory B cells that will remember that germ. This is how vaccines give you immunity.

**Metabolism and the Immune System**

Our bodies need lots of energy to live our day to day lives. We need energy to power our immune system and to do everything from reading, running... even sleeping and eating! All of the processes in your body that involve getting or spending energy are known as metabolism. A high metabolism occurs when your body is both getting a lot of energy and using a lot of energy, whereas a low metabolism occurs when the body does not have a sufficient quantity of energy to use. Our bodies get energy from food. A healthy diet is one that supplies our bodies with a balanced amount of sugars, fats, proteins, vitamins and all other nutrients we need to function properly.

See and do more with the immune system online!

Learn more about the Immune System online at:

http://www.sepa.duq.edu/regmed/immune

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**macrophage** - See white blood cells.

**memory** - Your immune system can remember what a germ looks like after it has been exposed to it. This way, you don’t get sick from the same thing twice.

**neutrophil** - See white blood cells.

**organism** - A living thing. Plants, animals and bacteria are organisms. A rock is not an organism because it is not alive.

**T cells** - See white blood cells.

**toxins** - Toxins are poisons that make us sick. Some bacteria release toxins in our body.

**viruses** - Viruses are usually smaller than a cell and cannot live on their own. They need to infect another organism and live in its cells.

**white blood cells** - There are many different kinds of immune cells; T cells and B cells are the white blood cells that do most of the fighting against germs. Here are some examples of white blood cells:

- **neutrophils** are the “first responders” to infections. They can call other immune cells when they find an infection.
- **macrophages** can “eat” germs or infected cells.
- **B cells** can also eat germs but they make antibodies which are special flags that stick to the germs and help the body get rid of them.
- **T cells** have many functions but, in particular, they can activate other immune cells, like B cells, to help fight disease. They can also directly kill infected cells.
Immune System Activity 1: Energize!

Your body needs a great deal of energy to help you complete your day-to-day activities, such as doing homework, playing soccer, or even reading a book! For any of these activities, even when you’re just sleeping, all of your cells need energy to continue being healthy. So, your body is constantly busy getting energy by eating food, storing the food energy (calories), and then spending it. All of the processes in your body that involve getting or spending energy are known as your **metabolism**. A high metabolism occurs when your body uses energy, whereas a low metabolism occurs when the body does not have a sufficient quantity of energy to use.

So where does your body get all of this energy from? Well, eating a healthy diet helps to provide your body with a great deal of its energy. The food you eat is broken down into smaller parts like sugars, fats, proteins, and other nutrients in a process called digestion. The broken-down nutrients are absorbed by the body, mostly in your intestine, and are then transported to every cell and tissue in your body with the help of your blood vessels. A special chemical helps cells absorb sugar from the bloodstream – it is called **insulin**. Sugar is one of the main sources of energy for the body so without insulin, most of the cells in your body would starve!

Our body uses chemicals like insulin to carefully regulate the amount of sugar in our body. Too much or too little can be harmful! Our body constantly decides how much sugar to store for later, how much sugar to have in our bloodstream for quick use, and how much sugar our cells need to live and stay healthy.

In some cases, like in the case of Type 1 Diabetes (Juvenile Diabetes), the body does not have enough insulin, so the cells can’t absorb sugars as well and the sugar level in the blood starts to rise. The body becomes tired, weak, dehydrated and blood pressure lowers, causing a coma if not treated quickly.

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**Keywords**

- *metabolism* - all the processes in our body that get and use energy.
- *nutrient* - a substance used in an organism’s metabolism which must be obtained from its environment.
- *sugar* - a nutrient needed for energy that can be found in many different forms, such as glucose, fructose, and sucrose (cooking sugar).
Materials
◊ 3 twelve-ounce plastic pop bottles or 4 equal graduated cylinders (350–400 mL)
◊ 3 balloons
◊ 1 funnel
◊ 1 plastic tray
◊ Masking tape
◊ Marker
◊ 1 packet of rapid rise active dry yeast
◊ 1 ¾ cup sugar
◊ 1 ½ cup warm water
◊ ½ teaspoon measuring spoon
◊ ¼ cup measuring cup
◊ ½ cup measuring cup
◊ Measuring tape
◊ Activity #1 Worksheets 1-7

Activity Summary
Similar to the human body, the single-celled organism, yeast, also has a metabolism. Just as your body breaks down sugars in food to provide you with energy, so does yeast. One of the results of sugars getting used for energy by yeast is the release of a gas called carbon dioxide (CO$_2$). So, the more carbon dioxide that is being released by yeast, the more energy the yeast is using to keep itself healthy!

What Will Your Students Be Doing?
Using yeast, water, kitchen sugar, and balloons, they will explore and observe the level of energy use (metabolism) of the yeast depending on how much food it has available!

Set-Up
Working in pairs, your students will need to gather all materials listed above. Remind students to read the directions carefully before starting their work!

Instructions
1. Using the masking tape and marker, your students will make 3 labels for their bottles. Each label will include the following information:
   - Label #1 - Bottle #1: Water, ¼ cup sugar, ½ teaspoon yeast
   - Label #2 - Bottle #2: Water, ½ cup sugar, ½ teaspoon yeast
   - Label #3 - Bottle #3: Water, ¾ cup sugar, ½ teaspoon yeast

2. Starting with Bottle #1, your students will measure the following amounts of each ingredient and place them inside the bottle using the funnel:
   - ½ teaspoon active dry yeast
   - ¼ cup sugar

3. Using Bottle #2, your students will next measure the following amounts of each ingredient and place them inside the bottle using the funnel:
   - ½ teaspoon active dry yeast
   - ½ cup sugar

4. Finally, your students will take Bottle #3 and measure the following amounts of each ingredient, placing them inside the bottle using the funnel:
   - ½ teaspoon active dry yeast
   - ¾ cup sugar

5. Next, the groups of partners will need to designate which partner will measure and fill each bottle with ½ cup warm water and which will place a balloon over the opening of each bottle.
   Partner #1: Measure ½ cup warm water and add it to Bottle #1 using the funnel.
   Partner #2: After Partner #1 adds the warm water, Partner #2 will need to quickly place the balloon on top of the opening of Bottle #1 and pull it down so it is securely over the mouthpiece. If their balloon will not stay on the bottle, they should use masking tape to secure it to the opening.
6. Partners #1 and #2 will continue the procedures stated in Step 5 for Bottle #2 and Bottle #3, adding the ingredients and covering each bottle with a balloon.

7. Students will then mix the contents of each bottle gently by jiggling the bottles. Next, they will need to use the measuring tape to quickly measure the circumference of each balloon. They will need to record their results on Worksheet #2 under Initial Observations. Then, using the equation provided, they will need to calculate the radius of each measurement. Finally, they will use the radius to calculate the diameter of each balloon using in the second equation provided.

8. After measuring and calculating the balloons’ circumferences and diameters, your students will observe what is happening to each balloon. They will then write down what they see on Worksheet #3 and draw a picture of their observations.

9. Students will then place all three of their bottles on their plastic tray. Working with their partner, students will move their trays and bottles to a warm, flat surface to sit for one hour (Note: the area under a window works well). After returning to their seats, your students will create their hypothesis by answering the following question on Worksheet #4: Predict what will happen to the balloon on each bottle after one hour.

10. After one hour is complete, students will return to their trays. Partners will then work together to quickly measure the circumference of each balloon using the measuring tape. Students will record their results on Worksheet #3 under Observation After 1 Hour. Then, using the equation provided, your students will find the radius of each measurement. Finally, using that value and the second equation provided, they will find the diameter of each balloon. Their answers will be recorded on Worksheet #2 in the area provided.

11. Your students will look at each of their bottles and each of their balloons. They will need to record their final observations on Worksheet #5.

Follow-Up

Your students will answer the following reflection questions on Worksheet #6:

◊ Which bottle released the most gas into the balloon?
◊ What does the amount of gas released tell you about each yeast culture?
◊ How was the metabolism of the yeast in Bottle #1 different than in Bottle #3?
◊ What do you think caused the difference in metabolisms between those two bottles?
◊ Was your hypothesis correct?
◊ If yeast metabolism is fueled by energy from sugar, what would happen to your metabolism if you had a high blood sugar level? A low blood sugar level?

What is Yeast?

Dry yeast is a single-celled, microscopic living organism often used in cooking as a leavening agent to help mixtures rise. Its main purpose in cooking is to convert sugars or starches into carbon dioxide. Using yeast as a leavening agent gives breads and other baked goods their airy texture. Dry yeast often comes in envelopes or jars. In this form, the organisms in the yeast are alive but inactive because they lack moisture. Once moisture is added, like water, the yeast is reactivated creating energy in the form of carbon dioxide.
Extension Activity: Sugar Vs. Sugar!

Discussion

In groups of four, your students will work together to brainstorm and identify seven sources of good sugars and seven sources of bad sugars. Students will record their group’s ideas on Worksheet #7. After their list is complete, groups will identify whether these sources of good and bad sugar are found in an Adult Diet, a Kid’s Diet, or Everyone’s Diet by marking the appropriate box with an “A” for Adult Diet, “K” for Kid’s Diet, or “E” for Everyone’s Diet. Once each group’s list is compiled, you will work with your students to make a class list of the top five “good sugars” and top five “bad sugars” identified by your students.

<table>
<thead>
<tr>
<th>Good (natural) sugars:</th>
<th>Bad (refined) sugars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fructose, the sugar found in fruits, vegetables and honey.</td>
<td>Sucrose, from sugar cane or sugar beet. Found in cakes, candy bars and other junk food.</td>
</tr>
<tr>
<td>Glucose, found in complex carbohydrates like bread and pasta.</td>
<td></td>
</tr>
<tr>
<td>Lactose, a sugar found in milk.</td>
<td></td>
</tr>
</tbody>
</table>

Activity

Option #1: If time permits, instruct your students to let their bottles sit overnight! When they return to the classroom the following morning, have them observe and record any changes that occurred from when they left their bottles the day before. These observations will be recorded on Worksheet #1. Your students will then draw a picture to show the changes they see.

After this is completed, your students will individually create a flip book using the four images they drew during this activity. Their flip books should show how the amount of CO₂ (carbon dioxide) gas released from each of the bottles changed over time. The final two pages of their flip book will each contain a graph showing the changes in circumference and diameter for each of the balloons. Chart #1 will document the changes in circumference in Balloons #1-#3 while Chart #2 will document the changes in diameter in Balloons #1-#3.

Their flip books should include the drawings they created on the following worksheets:

- Worksheet #3
- Worksheet #4 (Now Box)
- Worksheet #5
- The image from today
- Two charts: one documenting the changes in circumference of the balloons and the other documenting the changes in diameter of the balloons.

What healthy sources of sugar do you eat most often?
Option #2: Using the information your students discussed about sources of “good” sugar and “bad” sugar, they will design and create posters about choosing healthy foods. In groups of four, students will brainstorm an idea for a group poster, create a slogan for their idea, and design and produce a poster that promotes healthy foods. After creating these posters, students will present them to their classmates and hang them in the classroom, school halls, or cafeteria to promote and encourage healthy food choices for other students in the school!

Let’s Review….Natural Sugars are Better for You!

So what does all this information about sugar, metabolism, and its affects on health mean? As you saw, the balloons that contained the most sugar had the greatest productions of energy. But, yeast are simpler organisms than human beings; if you gave a human being that much sugar, their metabolism level would not be sustained and would quickly drop! But why? The human body has a very delicate mechanism that controls the use and storage of its sugars to allow for all the things we like to do, like run, learn, jump rope, and play videogames! Too much sugar can overwhelm the body’s ability to store and use sugar appropriately!

As you read above, eating too many foods that contain high levels of sugar - especially refined (white) sugar - can lead to serious health problems, including a weakened immune system, diabetes, and hyperglycemia. These problems occur because refined sugars are absorbed too quickly and force the body to work extra hard to keep a healthy balance of sugar in the blood. All that extra sugar gets turned into fat! When you eat too much sugar, it causes a rapid spike in your energy level and then a rapid drop, or “crash,” which makes you feel tired and yucky. Even though humans are much more complicated than yeast, sugars affect your metabolism just like they did in the balloon experiment.

A balanced diet that contains food with natural sugars is the healthiest because your body can control the balance of sugar more easily! A diet that follows these guidelines provides your body with more even levels of energy and less stress on your organs and immune system.

Not all sugars are created equal!
Refined sugars, like those in many junk foods, break down too quickly and cause a rapid increase in the amount of glucose in the blood - but it’s too much for the body to handle, so it leads to hyperactivity and eventually causes a “crash.”
Fructose, the sugar found in fruits, is broken down slowly and is actually healthy for the body!

Hyperglycemia:
(hyper = too much, glycemia = sugars)
When the level of sugar in the blood is unnaturally high. Can be caused by the ingestion of unhealthy sugars.

Read more about diabetes:
◊ http://www.sepa.duq.edu/regmed/autoimmune/autoimmuneintro.html

Discover more about sugars:
Immune Module

A Perfect Fit!

When white blood cells patrol your body, how do they tell the difference between your own cells and germs they find in their search? Well, different types of cells have different shapes. These different shapes allow your white blood cells, especially B cells and T cells, to tell the difference between what belongs to the body and what's harmful to the body. These two types of white blood cells have this ability because they have special receptors on their surfaces that match to a single, very specific target (antigen).

If a white blood cell comes across an unknown cell, it tries to identify whether it belongs to the body or whether it is harmful. The white blood cell uses its receptor to see if the shape on the unknown cell fits into its receptor. If this cell turns out to be a germ or an infected cell, the white blood cell becomes activated and the germ or infected cell is eliminated. This process allows the white blood cell to properly identify the unknown cell. If it weren't for receptors, your white cells wouldn't be able to know what is harmful and what is not!

Some T cells patrol the body checking every cell to see if is healthy and belongs to the body or whether it is sick or is harmful to the body!

T and B cells are specific.

This means that each T and B cell can only recognize one kind of germ or infected cell. To account for all the possible harmful cells that may enter your body, your body has to produce many, many different types of receptors. In other words, your body has to make billions of receptors that could possibly match any germ on the planet! With so many receptors being produced, there is a greater possibility that when a white blood cell comes into contact with a harmful substance, it will create an effective match and eliminate the intruder.

Vocabulary

Antigen - the shape on each cell or particle that white blood cells use their receptors to identify. Each antigen has a particular shape depending on what kind of cell it comes from.

Receptor - the part of the white blood cell that binds to the antigen.

Specificity - T and B cells are specific because each cell has a receptor that can only bind ONE kind of antigen from ONE type of germ.
So what happens when you are exposed to a germ? Your body makes millions of copies of the T and B cells that match the germ. These cells fight the infection until the germ is gone.

But what happens afterwards? Well, your body makes a special effort to keep some of the T and B cells that were specific for that germ. That way, the next time you come across the same germ, your body is already ready to find and get rid of it.

The Immune System Remembers!

This means that not only do receptors allow B cells and T cells to identify specific germs, but they also help these white blood cells remember the types of germs that have entered your body.

Materials

◊ Salt Dough (makes enough dough for one group of four students):
◊ Measuring cups
◊ Measuring spoons
◊ 4 bowls
◊ Water source
◊ Hot tap water*(microwaved)
◊ 2 cups flour
◊ 1/2 cup salt
◊ 3/4 cups hot water
◊ Worksheets #1-#5: Activity #3

Note* for safety: teacher should heat and handle hot water.

Activity Summary

Your students will be exploring the role of shape-matching in the immune system using salt dough clay. Working with a partner, students will mold clay “receptors” to fit a unique object, or “antigen” (like an eraser or other small object) - this is the target for your receptor. After the clay hardens overnight, these “receptors” and their “antigens” will be mixed up and redistributed. Students will walk around and try to match their receptors with the correct target. When a match is made, each pair will raise their hands and say, “Perfect Fit!” to signal that a match has been made.

The shapes of some targets will have very detailed and unique shapes making it easy to tell them apart from other targets. These kinds of targets will make the best fits with their receptors because it is certain that it is the correct target. The shapes of other targets might be less detailed and easily mistaken for another target. These make bad fits with their receptors because your students can’t be sure if the target is the correct one. After the students find their collection of targets, help them to identify whether each target will make “good fits” or “bad fits” with their receptor.

Set-Up Day 1

TEACHER SET-UP: Before starting this lesson, decide if you will assign partners or if you will allow your students to choose their partners. If you are assigning pairs, organize partners appropriately. Materials will also need to be organized and placed in an accessible area for students to collect them during the lesson.
STUDENT SET-UP: Working with a partner, your students will gather all materials before beginning. Remind students to read all of the directions carefully before starting the activity.

1. Each partner pair will need to find one small object in the classroom with a unique 3D shape (eraser, coin, small toy, Lego, etc). Once partners have found an item, they will sit back down at their seats and wait for the remaining pairs of partners to find their object.

2. Once each pair of partners has an object, students will write down the name of their target and predict if it will be a good fit or a bad fit on Worksheet #1 for Activity #3- A Perfect Fit! They will write an explanation and give an example of a good fit and a bad fit.

3. Now, each pair of students will hold up their object and tell the class their prediction and you will create a list on the board of all the objects and predictions. On this list, each item will be categorized as a “good” target (i.e.-one that will snugly fit with a receptor) or a “bad” target (i.e.-one that will be difficult to match because its shape could match many receptors). For example, it would be hard to tell the difference between a pencil and a pen, but not difficult to tell the difference between the tip of the pencil and the eraser. The students will record these responses on Worksheet #2 for Activity #3- A Perfect Fit!

4. Partner #2 will retrieve the ingredients and supplies needed to make the salt-dough.

5. Working together, Partner #1 and Partner #2 will complete the following steps together to create their salt-dough:
   a. Carefully measure 2 cups of flour and place into bowl #1.
   b. Carefully measure 1/2 cup of salt and place into bowl #2.
   c. You will measure 3/4 cups of hot water for each pair of students.
   d. Combine the flour from bowl #1 and the salt from bowl #2 and place them in a large mixing bowl (bowl #4).
   e. Then, students will slowly and carefully add the water from bowl #3, kneading the mixture until it becomes sticky. (Note: If the mixture becomes too runny, add a little more flour. If it becomes too crumbly, add more water.)
   f. When their dough is completely mixed, Partner #1 will form the dough into a baseball-sized ball. Make sure they have enough dough to squish that pair’s item into the dough without changing the overall shape of their dough-ball.

6. Partner #1 will press half of their chosen object into the salt-dough, leaving an imprint of the object. Once pressed inside, the object will form a “pocket” in the shape of their object! Remind students it is important that only ½ of the object is pressed into the clay so that the remaining half sticks out of the pocket (otherwise they won’t be able to get it out!).

7. Student pairs will remove the object from their salt-dough receptor and place the receptor in a safe spot to dry overnight.

Note: Make sure students choose enough objects for half of your class!
Instructions - Day 2

Now that the salt-dough is dry, it’s time for your students to find the “targets” that match! If a student chose an object yesterday to use during this activity, they will be assigned to choosing a salt-dough receptor today. On the other hand, if a student made a receptor yesterday out of salt-dough, that student will choose a target to match to a receptor today. Instruct them to choose receptors and targets different from the ones they had yesterday!

1. After choosing their receptor or target, students will take their object and walk around the room and try to find the missing half of the pair! So, if a student has a receptor (the dried, salt-dough ball) they will be looking for the specific target (the one that fits inside the indentation on the salt-dough ball). On the other hand, if a student has a target they will be looking for the receptor (dried, salt-dough ball) it fits inside. Encourage students that if they can’t find the match right away, they should not get frustrated. They should keep trying!

2. When one student makes a correct match with another student, the new pair should raise their hands and say, “Perfect Fit!”

3. Using the list of the predictions for each target that the class compiled during yesterday’s class, work together as a class to check if the hypothesis for the item you used today was correct. On Worksheet #3, students will record what item they used today, its prediction as a good or bad fit from yesterday, its actual results today as a good or bad fit, and reasons why the outcome was the same or different from yesterday’s prediction.

4. On Worksheet #4, students will create a labeled drawing of the match they created with their new partner today. In the additional space provided, students will draw and label one object they observed during today’s activity that did not create a good match.

Reflection

Students will complete Worksheet #5 by discussing how the characteristics of the binding process (specificity, ability to recognize, and memory) affect the process of identifying matching antigens and receptors. After completing the first question, students will answer the second question by identifying and describing three real life situations where this kind of “perfect fit” must occur (e.g., only the right key will open a lock) or where unique recognition occurs (e.g., recognizing a friend’s face, no one has a face like theirs).

Discussion

In groups of 4-5, students will work together to discuss the following questions and develop answers based on their results from the A Perfect Fit! Activity.

◊ Why is specific binding between antigens and receptors important to the immune system?

◊ What processes does this mechanism rely on?

◊ During the activity, a salt dough receptor was matched to a specific object from inside the classroom. What did this represent?

◊ Why are binding and recognition important for the immune system?
All of your white blood cells work together to eliminate germs from your body. In this board game, you will use your brains and the white blood cell “money” in your “Blood Bank” to fight 10 common diseases while you learn more about the Immune System. As you move throughout the game board, you will encounter viruses and bacteria, so watch out! You will also learn more about staying healthy, vaccines, antibiotics, and steps you can take to prevent the spread of disease.

Lesson Preparation

1. Before playing the game, print out copies of the game board, the answer sheet, Disease Cards, Health Tip Cards, White Blood Cell “money” and fold-up game pieces.

2. Students will be working in groups of four. Decide if you will assign students to groups of four or if you will allow your students to choose their groups. If you are assigning groups, organize students appropriately.

3. Groups of students can work together to:
   - Tape together the board, cut out the currency and game pieces.
   - Students will decide which two group members will cut out the currency and game pieces and which two group members will assemble the game board. For extra strength, those two group members can glue the game board pieces to poster board or cardboard and let dry overnight.
   - If you’d like to re-use the game without reprinting, laminating is a good way to protect it.

Before Students Begin

1. Introduce the key terms (on the last page of this document) used in the game. Ask students if they have heard of the words before or know what each means. Guide students to a correct definition of each key term to help them become comfortable with the language of the Immune System. Encourage them to ask for help if they encounter a word they don’t remember while they are playing.

2. Have your students quiz each other about the key terms before beginning the game so they are comfortable with the words used.
Play the Game!

1. After each group has their game board and game pieces assembled, students will take turns reading the instructions for the game aloud while you describe the main aspects of the game board and the basics of game play.

2. Students will then break into their groups of four and play the game.

Get Home from the Hospital!
The objective is to make it around the board from the Hospital to your Home square and accumulate the most Disease Cards and White Blood Cells!

- Each player picks a color and sits beside those Home and Hospital Squares. Place your playing piece on your Hospital square.
- Select one player to be the “banker”. He or she will manage the money in the “Blood Bank.” To begin the game, the banker gives each player 500 White Blood Cells.
- To start, each player will put their game piece on the “Hospital” square. Then, roll the die to see which player goes first. The person with the highest number will begin the game, and continue clockwise from the first player.
- Player #1 will roll the die and move forward that number of squares on the board. For example, if they rolled a 5, then they would move ahead five squares. Once Player #1 lands on the correct square, they will follow the directions on the board.
- As the students land on different types of squares, they should follow the directions in the “Rules” on the next page.
- Each additional player will take their turn and follow the same Rules.
- The game is over when someone reaches their Home square.
- The player who gets Home first gets a bonus of 50 White Blood Cells.
- To figure out who wins, every player must add up their White Blood Cell “dollars” and the values on the bottom of each of their Health Cards and Disease Cards to find their total. Whoever has the most White Blood Cells wins!

Discussion/Review

Students will work in groups of 3-4 to create a poster for one of the questions below. Assign each group one of the following:

- What are common things that can harm your body? (viruses, bacteria, fungus)
- What are some examples of diseases caused by virus?
- What are some examples of diseases caused by bacteria?
- What do antibiotics work well against?
- What types of cells make antibodies?
- What does it mean to be specific?
- What kinds of cells give the immune system MEMORY?
- Name three kinds of cells that make up the immune system.

Answers to these questions will be written and explained on the poster. Students can include an illustration as well. Groups will then present their question and group poster to the class.
The Rules

◊ If you land on a Disease Card square:
  ◊ Draw a card from the Disease Card pile.
  ◊ Read the card aloud and try to answer the question correctly. If you get it correct, you prevent yourself from getting sick by using your knowledge, so you win that Disease Card, and your turn is over.
  ◊ If your answer is incorrect, you will have to use your White Blood Cells to “fight” the disease. Pay the Blood Bank the amount of White Blood Cells at the bottom of that card.
  ◊ When you have successfully “paid for” a disease, you win the card for that disease, and your turn is ended.
  ◊ If you don’t know the right answer and don’t have enough White Blood Cells to pay for it, go to your Hospital.

◊ If you land on a Health Card square:
  ◊ Draw a card from the Health pile.
  ◊ Read the card aloud, then collect the amount of White Blood Cells listed on the card from the Blood Bank.

◊ If you land on a Yay! square:
  ◊ When a player lands on a Yay! square, they are awarded 50 White Blood Cells from the Blood Bank for participating in a health activity to keep their immune system strong.

◊ If you land on an Eew! square:
  ◊ When a player lands on an Eew! square, they must pay 50 White Blood Cells to the Blood Bank for doing something that hurts their immune system.

◊ If you land on a space occupied by another player: You Make Me Sick!
  ◊ If a player lands on a space occupied by another player, they can “infect” them with one of their Disease Cards.
  ◊ To infect another player, choose one of your Disease Cards and read the question to the other player.
  ◊ If the player answers correctly, they have prevented the disease by being smart and do not get sick. They win the disease card, and stay on their square. The player who asked the question shares the square with the other player.
  ◊ If the other player does not answer correctly, they must pay the amount of White Blood Cells to the player asking the question. Since they could not use their knowledge to fight the disease, they get sick! and must return to their Hospital. The player who asked the question takes over that square.

◊ If you get sent to the Hospital:
  ◊ If a player runs out of White Blood Cells and can’t pay for a disease card, they get sick! and go back to their hospital.
  ◊ To leave the hospital, you must “pay” for treatment by reading 2 Health cards about new ways to stay healthy and earn 100 White Blood Cells in return.
  ◊ If you land on a different player’s hospital, nothing happens.
Answer Sheet for You Make Me Sick!

1. 1 - A virus is a germ that can’t live on its own, but bacteria can. 2 - Viruses have to infect cells to live.
2. The common cold has symptoms of a runny nose, cough, sneezing and fatigue.
3. 1 - Antibodies mark the virus so that special cells called Macrophage will “eat” the virus. 2 - Antibodies cripple viruses so they can’t infect cells, 3 - Antibodies will also immobilize the germ they are covering.
4. A vaccine is like a Most Wanted sign that helps your immune system learn to recognize a new germ by exposing it to a neutralized version of the germ.
5. True
6. The lungs
7. Cover your nose and mouth when you sneeze or cough.
8. Virus
9. False
10. The skin
11. They give you immunity – they show your immune system what the germ looks like.
12. True
13. Bacteria are single-celled organisms. They can be good (you have some helpful bacteria in your intestine that help digestive food!) or bad.
14. Fever makes your body temperature too high for the bacteria so they die.
16. Sore throat, fever, difficulty swallowing.
17. Yes
18. Nerve cells (neurons) – these cells make your muscles move and send signals between your body and brain.
19. Nope. Puncture wounds like those caused by nails are ideal places for tetanus to grow. Always clean wounds with antibacterial soap and water.
20. A bacteria (a toxin released by a bacteria)
21. Yes
22. Neutrophils – they are the “beat cops” of the immune system and are often the first to the site of infection.
23. Wash hands before and after touching your eyes.
Pink eye is caused by bacteria!

True

Itchy red bumps or rash, fever, runny nose

When a disease is contagious, it means that it can be easily spread to other people.

B cells

Paralysis

Virus

Macrophage

True

1. Bacteria can make copies of themselves outside, between your cells, but viruses make copies of themselves inside your cells. 2. Bacterial infections can be treated with antibiotics, but viral infections cannot. 3. Bacteria rarely infect your cells, viruses must infect your cells.

Ear ache, stuffy nose, ear “popping”.

B cells produce antibodies. Antibodies are flags that help your body kill germs.

False, Ear Infections can be caused by bacteria or viruses.

True

Nausea, abdominal pain, vomiting, diarrhea, fever or headache.

A toxin is a poison that is made by a living thing – like a bacteria or plant. Poisons found around the house, like cleaning supplies, are made by humans and are not toxins.

The T cells are the “Police Chiefs” of the immune system.
Key Terms

**Antibodies:** Special “red flags” that stick to toxins, bacteria and viruses. They cover any invaders to tell the immune system to get rid of the germs or toxins.

**Bacteria:** Bacteria are single-celled organisms that can be good or bad. Our Immune System fights off the bad ones. We use Antibiotics to get rid of bad bacteria.

**Cell:** All living things are made of cells. Living things can be made up of only one cell like bacteria or millions and millions of cells like human beings. There are many different kinds: hair cells, skin cells, plant cells, etc. We are made of many different types of cells, but some organisms are only one cell, like bacteria.

**Contagious:** When a disease can be easily spread to another person, it is contagious.

**Disinfectant:** Chemicals that kill germs on the outside of your body, like soap.

**Germ:** An organism that infects our bodies and makes us sick (causes disease). The two most common types of germs are bacteria and viruses.

**Immune system:** Tissues, cells and organs that detect and fights infections caused by germs in our bodies to keep us healthy. Your Immune System is always learning. You can’t live without it!

**Immunity:** When your white blood cells can get rid of certain germs in your body before they ever have a chance to make you sick.

**Infection:** When a disease-causing organism (a germ) enters our bodies and makes us sick.

**Organism:** A living thing. Plants, animals and bacteria are organisms. A rock is not an organism.

**Sickness:** We feel sick when a germ infects our cells and our immune system is fighting hard to get rid of it. For example, a fever makes your body too hot for germs to survive, and runny noses, sneezing and coughing are all ways the body uses to get the germs out of the body.

**Toxins:** Some bacteria release toxins in our body. Toxins are poisons that make us sick. Our immune system can neutralize toxins with special “shields” called antibodies.

**Vaccines:** Vaccines give you immunity. They are like Most Wanted signs for your immune system. They help your immune system learn what the germs look like, so they can find them faster, so you don’t get sick. Your immune system will remember what those germs look like for the rest of your life.

**Viruses:** Viruses are very small (usually smaller than a cell) that cannot live on their own; they need to infect another organism and live in their cells.

**White blood cells:** There are lots of different kinds of immune cells; T cells and B cells do most of the fighting against germs.

- **B cells** make antibodies, which are special flags that stick to the germs and help the body get rid of them.
- **Macrophage** can “eat” the germs or infected cells.
- **T cells** are the “commanders” of our immune system and can activate other immune cells, like B cells, to help fight disease.