*Unit 2: Lesson 1 – Development of Disease*

**Vocabulary: Development of Disease**
Using resources suggested by your teacher, find definitions for the terms below.

| | |
|---|---|
| Adaptive immunity | |
| Antigenic novelty | |
| Antigenic variation | |
| Chronic infection | |
| Latency | |
| Persistence | |
| Programmed gene rearrangement | |
| Resistance | |

**Refer to the online glossary and compare your definitions with those in the glossary. Make any necessary corrections to your definitions above.**

## Activity 1 Development of Disease—Infection Simulation

**Development of Disease Game**

**Materials**

- 50 blank index cards (per group of 11 players)

- Marker pen

- Decahedral die or two six-sided dice (optional)

**Instructions**

- Work in a large group, up to 11 players. If you have more than 11 in your group, assign one or two people as observers to record the activity. If you have fewer than 11, you can assign one or more players to play more cards than indicated below.

- Choose one person to be the immune system (IM player). All the other players are pathogens (P players).

- The IM player gets 10 blank index cards.

- Divide a second set of 10 blank cards equally among the P players, so each of the P players gets one index card. (If you have fewer than 11 players, one or more players will need more than one card.) Ideally, these cards will be a different color from the IM player's cards.

- The IM player uses the marker pen to write one letter on each card, A through J. Therefore, the IM player has 10 cards, each with one letter.

- The P players write a letter A through J on their cards, ensuring that no player writes the same letter.

- Each P player is randomly numbered 1 through 10 (or up to the number of P players). Players keep this number throughout the game.

**Game Version 1**

*Set up*

- The P players play with one card each, labeled A, B, or C and so on.

- The IM plays with 10 cards labeled A through J.

*Procedure*

- Round 1

    1. The IM player chooses two cards with different letters (e.g., A and B).

    2. For the first turn, the IM player rolls the decahedral dice and calls the number out. (If a decahedral dice is not available, a spreadsheet can be used to generate sets of random numbers from 1 to 10.)

    3. The P player assigned that number presents their card with its letter to the IM player.

    4. If the letter <u>does not</u> match (e.g., P player presents C and IM player has B etc.), the IM player loses. Go to Round 2.

    5. If the letter <u>does match</u> the P player (e.g., P player presents B and IM player has B etc.), the IM player <u>takes their card</u> for the round, and takes a second turn. The P player now does not have a card and withdraws from this round.

    6. For the second turn, the IM player again rolls the die (or chooses a random number from 1 to 10), except the number chosen in the first turn, and calls it out. Play proceeds as before (from Step 3), with the IM player again choosing a random number from 1 to 10, except numbers chosen in previous turns.

    7. Play continues until the IM player loses, and begins Round 2.

- Round 2

    1. The IM player returns any forfeited cards to the corresponding P player. The P players again have only one card each.

    2. The IM player chooses 2 additional letters with which to match the P players' cards (e.g., A, B, C, D).

3.  The IM player chooses a random number from 1 to 10, and play proceeds as in Round 1 (Steps 3 to 7). When the IM player loses proceed to Round 3.

- Rounds 3 to 5

    1.  For each subsequent round, the IM player chooses 2 additional letters with which to recognize the pathogen. The IM player therefore will have 10 letters in Round 5.

*Questions for Game Version 1*

1.  How many turns (times the IM player called a number) did it take in Round 1 before the IM player lost the turn?

2.  How many turns did it take in Round 2, 3 and 4 before the IM player lost the turn?

3.  What happened in Round 5 that was different from previous rounds? Explain your answer.

4.  Is there a pattern in the number of turns taken in successive rounds before the IM player lost? Explain your answer.

5.  In Round 1, what is the probability that the IM player loses on the first turn? Explain your answer and show your calculation.

6.  In Round 5, what is the probability that the IM player loses on any given turn? Explain your answer.

**Game Version 2**

*Set up*

- Each P player takes another index card.

- Each P player writes on the new index card the same letter they used to play in Game Version One. Both of these cards are now in play (e.g., one player will have cards A and A, another will have B and B, etc.).

*Procedure*

- Play proceeds as in Game Version 1. However, in this version, the IM player has two lives. Therefore if the IM player's card does not match the P player's card, the IM player can roll the decahedral dice twice to call two additional numbers.

- As in Game Version 1, when the P player's card letter matches cards held by the IM player, the P player gives up their card for that round, and then receives it back to play in the next round.

- Play Game Version 2 for 12 rounds and then answer the questions.

*Questions for Game Version 2*

1. How many turns (times the IM player called a number) did it take in Round 1 before the IM player lost the turn?


2. In Round 1, what is the probability that the IM player loses after two throws? Explain your answer and show your calculation.


3. What can you conclude about the number of rounds it would take for the IM player's cards to match all the P player's cards?

**Game Version 3**

*Set up*

- P players swap one of their two cards that have the same letter (see Instructions) with other P players.

- Each P player will have two cards, but with different letters. Both these cards are now in play (e.g., one player will have cards A and B, another will have B and C, etc.).

*Procedure*

- Play proceeds as in Game Version 2.

- Remember that each time the P player's card letter matches cards held by the IM player, the P player gives up their card for that round, and then receives it back to play in the next round.

- Play Game Version 3 for 12 rounds and then answer the questions.

*Questions for Game Version 3*

1.  How many turns (times the IM player called a number) did it take in Round 1 before the IM player lost the turn?

2.  In Round 1, what is the probability that the IM player survives for two throws? Explain your answer and show your calculation.

**Game Version 4**

*Set up*

- Players play with just one of their cards, so they play with one card each, labeled A, B, or C and so on.

*Procedure*

- Play proceeds as in Game Version 1, playing with cards A through J.

- However, in Step 5 of each round, if the card matches, the IM player and the P player each throw the dice. The higher throw wins. If the IM player throws a higher number, the IM player takes the P player's card as before, and calls out another number.  If the P player throws a higher number, he or she keeps their card, and the IM player loses and the game goes to the next round.

- Play Game Version 3 for 12 rounds and then answer the questions.

*Question for Game Version 4*

1. In Round 1, what is the probability that the IM player loses on the first turn? Explain your answer and show your calculation.

**Activity Questions**

1. How does this activity simulate active pathogens?

2. What part of the activity represents the immune system recognizing the pathogen?

3. How does this activity simulate the immune system neutralizing the pathogen?

4. Does this activity represent the adaptive or innate immune system? Explain your answer.

5. How was antigenic novelty represented in the activity? Explain your answer.
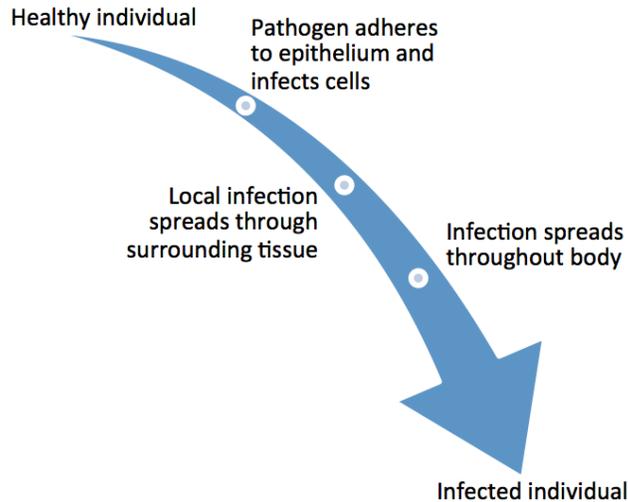
6. How was antigenic variation represented in the activity? Explain your answer.

7. How was persistence represented in the activity? Explain your answer.

8. How was resistance represented in the activity? Explain your answer.

## Activity 2: Development of Disease—The Infection Process

The steps of the infection process are shown below:



Consider the ways that pathogens adapt, enabling them to continue causing infections. Complete the following:

1. On the above diagram of an infection arc, indicate where the pathogen may overcome the immune system response. Use the letters below to indicate each on the diagram. You may use a letter more than once. Explain the placement of each letter.
   a. Antigenic novelty
   b. Antigenic variation
   c. Persistence
   d. Resistance

2. What happens to the pathogen if it cannot reproduce, and what are the consequences?

3. What process enables the pathogen to overcome the immune system?

4. Using resources provided by your teacher, research one of the following pathogens and identify how it has evolved to circumvent the immune system:

a. *Streptococcus pneumoniae*
b. African trypanosomes (sleeping sickness)
c. Herpes simplex virus
d. Varicella zoster virus (chickenpox)

e. Epstein-Barr virus
f. Hepatitis B virus
g. *Mycobacterium tuberculosis*
h. *Listeria monocytogenes*
i. Human immunodeficiency virus  (HIV)

4. Create a presentation to describe the development of your chosen disease and the immune response. You may use any appropriate media for your presentation. Briefly explain why you chose that particular medium.

Indicate medium used:

☐Slide presentation     ☐Poster          ☐Web page          ☐Video

☐Podcast                ☐Brochure        ☐Mobile app        ☐ Other_____

Why did you choose this medium?

5. What was one piece of new information you learned in this lesson and why was that of interest to you?