Immunity and the Spread Of Influenza Within a Population

Resource Type: Curriculum: Classroom

Publication Date: 9/28/2007

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Abstract

In this activity students will observe the spread of influenza in two hypothetical populations. The students will be able to see how influenza affects individuals of different ages and with different risk factors. They will compare the spread and outcome of influenza in a population where less than 20% are vaccinated to a population where greater than 70% are vaccinated. The students will each play a character in these hypothetical populations and the class will gather, analyze, and discuss data on prevalence, mortality, recovery, and vaccination rate.

Activity

Invitation for User Feedback. If you have used the activity and would like to provide feedback, please send an e-mail to MicrobeLibrary@asmusa.org. Feedback can include ideas which complement the activity and new approaches for implementing the activity. Your comments will be added to the activity under a separate section labeled "Feedback." Comments may be edited.

Learning objectives.

At the completion of this exercise students will:

1. comprehend how increased immunity within a population can help to prevent spread of a disease.
2. explain why it is difficult to achieve effective population immunity with the influenza vaccine.
3. extrapolate the effects and complications of influenza on individuals of various ages with various risk factors.
4. analyze the data generated.

Background.

The students should have some background on vaccines and influenza. For instance, they should understand how vaccines work. They should also comprehend that vaccines are used to prevent disease and to decrease the spread of disease. They should also know the basics of the influenza virus and how influenza is spread.

PROCEDURE

Materials.

- Character cards (sample cards provided in Appendix)
- Infection cards (sample cards provided in Appendix)
- Vaccine cards (sample cards provided in Appendix)
- Blackboard, whiteboard, overhead projector or "ELMO" projector for collecting and displaying raw data to the students

Student Version.

Provided as a handout: Student version
Instructor Version.

Provided as a handout: Instructor version

Safety Issues.

NA

Suggestions for determining student learning.

I have successfully used these assessment methods for this exercise:

- I asked my students to complete the preexercise questions (student version handout) using the web and/or book resources prior to coming to class. I directed them to the various resources such as those listed in the references. I wanted my students to think about the material prior to completing the demonstration. I then gave them a quiz over those questions immediately before we started the exercise.

- During the activity the students were instructed to use a report sheet, like the one provided in the student version of the instructions, to gather data and attempt to answer the discussion questions. This report sheet helps the student to put the data into perspective and helps to guide the in-class discussion.

- I used think-pair-share after the data was collected. The students were instructed to pair up with two or three individuals to have small group discussions for 10 to 15 minutes. They used the discussion questions provided in the student version handout to help guide them. In addition to discussing the questions, each group was asked to come up with at least one of their own discussion questions as well (something they wanted to know or something they didn't quite understand). For instance, many groups don't understand why the vaccine in the activity was not 100% effective in a healthy individual. Each group was required to give a synopsis of their discussion and indicate any questions they didn't understand. This generated a class discussion. I also helped to fill in the gaps during the discussion with explanations about genetic shift and drift, vaccine effectiveness, the replication strategy of RNA viruses, etc. After the think-pair-share is complete, each student is given the opportunity to individually complete the discussion questions (in the student version handout) or a 1-minute paper over the concept of population immunity for a grade.

- I typically include the material from the activity on a quiz and exam during another class period.

Field Testing.

This exercise was field tested in three types of classes: precollege biology class, biology majors microbiology class (junior level), and prenursing microbiology class (sophomore level).

Precollege Biology Class (Allied Health Summer Camp with 23 recent high school graduates)

- A prequiz and a postquiz were given to these students. Out of 23 students, 16 showed at least a 20% higher postquiz grade as compared to the prequiz grade, and five showed no change in scores between the prequiz and postquiz. The average grade of all the postquizzes was 37% higher than the average grade of the prequizzes. Examples of pre- and postquizzes are provided in the Appendix.

Biology Majors Microbiology Class

- A prequiz and a postquiz were given to these students. Out of 24 students, 7 scored at least a 10% higher postquiz grade as compared to the prequiz grade, and 10 showed no change in scores between the prequiz and postquiz. The average grade of all the postquizzes was 20% higher than the average grade of the prequizzes.

- Comments were collected from students. Twenty out of 24 comments were positive, while four students felt that the activity did not help them. Students felt that they comprehended population immunity and spread of disease better after completing the exercise. Some actual comments from students are linked in the Appendix.

Prenursing Microbiology Class

- Prequizzes were not administered; however, the information from the activity was included on their chapter exam. The majority of the students successfully answered greater than 75% of the exam questions over this material.

- Comments were collected from students. Twenty-two out of 30 comments were positive and students felt that they comprehended population immunity and spread of disease better after completing the exercise. Some actual comments from students are linked in the Appendix.

Student Data.

Students were asked if the activity helped them to better understand population immunity dynamics and if they liked participating in the activity. The majority of students in all three classes responded positively (either in writing or verbally). Some examples of student comments are linked in the Appendix. A minority of students did not like the activity and felt that it was distracting, confusing, or did not assist with understanding immunity. If the instructor is not careful about organizing the data collection, then students might experience confusion. If the class is not cooperative or motivated to be involved in discussion, then the activity may not work. I felt that the activity worked best in the prenursing microbiology class and the precollege biology class (nursing camp). These students appeared to be more motivated and engaged in the
activity. An example of an actual student data report sheet is provided as an example. Some examples of questions used on pre- and postquizzes are linked as well.

SUPPLEMENTARY MATERIALS

Possible Modifications.

My cards were made using information from the Centers for Disease Control and Prevention website on influenza; however, the instructor can opt to make his/her own character cards to represent any type of population (a daycare, a nursing home, etc.). Alternatively, students can be instructed to make their own character cards prior to coming to class based on their own preferences and information from the Centers for Disease Control and Prevention. The instructor can ask the students to include all of the elements found on the example cards.

The activity can be modified to observe how hand washing might affect the results of spread of influenza. This can be achieved by adding an extra step where the exposed individuals choose a random number. This number can be compared to a probability that washing his/her hands actually prevented the disease transmission. Two rounds can be performed: one where hands are hypothetically washed after each round and one where hands are not washed.

References.


Online Resources.

- Access Excellence at the National Health Museum
  http://www.accessexcellence.org/AE/AEC/CC/vaccines_how_why.html
- The Centers for Disease Control and Prevention (Vaccines)
  http://www.cdc.gov/vaccines/
- Molecular Expression @ Florida State University
  http://micro.magnet.fsu.edu/cells/viruses/influenzavirus.html
- The Centers for Disease Control and Prevention (Influenza)
  http://www.cdc.gov/flu/
- The Big Picture book of Viruses (Tulane University)
  http://www.tulane.edu/~dmsander/Big_Virology/BVHomePage.html

Appendices and Answer Keys.

- Instructor version
- Student version
- Character cards
- Vaccine cards
- Infection cards
- Answer key to discussion questions
- Example quiz
- Example quiz answers
- Comments collected from students
- Example data collected from students
Immunity and the Spread of Influenza within a Population
Instructor Version

Special note: this activity works well with a class that has greater than 20 students. It has not been conducted with classes smaller than 20 students.

Instructor preparation (prepare before going to class)
Create character cards that represent a population you are interested in studying. Character cards are provided in the Appendix. You could copy and use these cards or create your own to represent a specific type of population you want to model. I have provided guidance on how to use the sample character cards in the “Character Cards” document. Alternatively you might have your students create their own character cards (based on their own risk factors or lifestyle). The idea is to create characters with and without risk factors. The risk factors can be anything that affects the efficacy of the influenza vaccine and/or the outcome of the disease if that character was infected with influenza. Information about influenza vaccine efficacy and the likely outcomes of the disease in various individuals (i.e., elderly, children, immunocompromised individuals) can be found on the Centers for Disease Control and Prevention (CDC) website (www.cdc.gov/flu). Each character card should contain the following:

- **Age**: the age of the character will determine the effectiveness of the vaccine in that individual, whether or not the character can be vaccinated (the vaccine is not recommended for children under 6 months), and the complications and final conclusions the character will experience if he/she is infected with influenza.
- **Risk Factors**: some characters may have risk factors such as diabetes or heart disease. Risk Factors are not necessary for every character. If a character is going to have a risk factor, then a brief description should be provided. Risk factors will influence how the disease affects the individual and could affect the efficacy of the vaccine.
- **Conclusion**: describes what would hypothetically happen to that character if he/she was infected with influenza.
- **Vaccine Efficacy**: this represents the chance that the vaccine is effective in a vaccinated person who is exposed to influenza. For the sample character cards, I generated this number based on reports from the CDC website on the inactivated influenza virus vaccine in various individuals (www.cdc.gov/flu). The CDC reports a range for vaccine effectiveness; therefore, to simplify the process I chose a single number that fell within that range. Notice that the effectiveness of the vaccine changes with age and other risk factors. For instance the vaccine is 70 to 90% effective in adults <65 years old and 30 to 70% effective in adults over 65.

Create a second deck of cards with each card labeled “vaccinated” and a third deck with each card labeled “infected.” Example cards that can be used for each deck are found in the Appendix along with explanations about the cards.
Student preparation
The students should be given a homework assignment prior to participating in the activity in class (see student version). I found that this works well to prime the students if they don’t have a strong background in influenza and vaccination. I typically provide the students with web resources and direct them to the microbiology textbook for information on vaccines and influenza.

In-class instructions

Influenza Activity Example A. Modeling influenza spread in a typical population
1. Randomly distribute the character cards to the class. Each student should get one character card. The class represents a hypothetical population.
2. Determine who will be vaccinated. In this first example you should determine which students have actually been vaccinated during the current flu season (or the previous one, depending on what time of year the activity takes place). All students who have been vaccinated should receive a “vaccinated” card. You will probably find that a very small percentage of your class has actually been vaccinated, which is great for demonstrating the spread of the disease. Note: if the natural vaccination rate for your class is actually greater than 50%, you might opt to choose only 20% of your class to be vaccinated in the first demonstration so that it contrasts well with the Example B demonstration.
3. Each student who has been vaccinated should write down the last two digits of his/her social security number. This number will represent a random number (00-99) to be used to determine if the vaccine was actually effective (00 will represent the number 100). He/she will compare this number to the number range described in the vaccine efficacy portion of the character card when and if exposure occurs.
4. After distributing all cards, the students should determine the percentage of the population vaccinated and record this information.
5. Give an “infected” card to one or a couple of students in the middle of the room and explain to the class that these persons entered the population (e.g., town, school, or work place) and were infected. Note: start with an infection rate of about 5 or 10%.
6. Now the class will go through several rounds of play where the following takes place.
   a. All infected individuals reach out and randomly select one to three people sitting near them to be exposed. Exposure can be represented as a simple handshake.
   b. Any student thus exposed who was neither vaccinated nor already infected must obtain an “infected” card to signify that he/she has contracted influenza. Note: this action assumes that every unvaccinated person who is exposed actually becomes infected. While this is not realistic, it simplifies the activity tremendously.
   c. Any student who has been vaccinated should look at the Vaccine Efficacy on his/her character card and compare this to the last two digits of his/her
social security number. If this number is within the range listed on the character card, then the vaccine was effective and the character is not infected. All others should obtain an “infected” card.

d. After the students determine if they have become infected, the round ends.

e. Repeat steps a through d two or three more times. Note: the infected students should each pick at least one person who has not already been infected during step a.

7. Cycle through about three or four rounds total. The activity can stop when each student has been exposed or simply after a fixed number of rounds.

8. Each student should read the conclusion on the character card, and data should be collected on the board. Tables 1 and 2 (below) can be used to collect data.

9. Spend some time gathering data from the class and calling on some students, especially those with risk factors listed or those over the age of 60 or under 2 years old, to share their conclusions. Collect data using a blackboard, whiteboard, overhead, or projected document.

**Collecting general data**

Do a headcount for the following information and provide the numbers on the board so students can calculate correct percentages on their report sheets.

Table 1. Example of a table that can be provided on the front board for collecting general data from example A.

<table>
<thead>
<tr>
<th>Number of students in the population</th>
<th>Total number of students that had the vaccine</th>
<th>Total number of students that became infected</th>
</tr>
</thead>
</table>

**Collecting age data from students**

Collecting the age data from the students can become confusing. I have found this method is the best way to do it. Ask your students the following, then get a count of hands and record the data on the front board or some place the students can see it. Table 2 is an example of a table that can be used for this purpose.

1. Raise your hand if you were 0 to 6 months old (or say the other age ranges in the table).

2. Keep your hand up if you were infected.

3. Keep your hand up if you had complications.

4. Keep your hand up if you died.

5. Next ask the same questions 1 through 4 for those in other age groups and record the information on the front board or some place the students can see it.

6. Ask students in each age range to record their recovery time on the board so you can have them calculate an average.
Special note on data collection
Depending on the level of your class you may need to help the students think through how to calculate each of the percentages indicated on their report sheets. For instance, when they are asked to calculate the percentage of infected individuals with complications, they will tend to divide the number of those with complications by the total number in that group instead of by the number infected in that group. They also have a tendency to forget to calculate a percentage and instead simply transfer the raw numbers provided on the board to their report sheets. I have provided sample tables below for collecting numbers of individuals in each category. It is up to the students to calculate the correct percentages indicated on their report sheets.

Table 2. Example of a table that can be provided on the front board for collecting age and infection data from Example A

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Total number</th>
<th>Number infected</th>
<th>Number with complications</th>
<th>Number that died</th>
<th>Recovery time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6 mos.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 mos.–1 yr.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 yrs.–15 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 yrs.–60 yrs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 60 yrs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Instructions: recreate this table on an overhead or a board and supply the numbers as they are gathered from the class. Ask your students to fill in their various recovery times so that the average recovery times can be calculated by the class.

Collecting risk factor data
Ask your students the following, then get a count of hands and record the data on the front board or some place the students can see it. Table 3 is an example of a table that can be used for this purpose.

7 Raise your hand if you had a risk factor.
8 Keep your hand up if you were infected.
9 Keep your hand up if you experienced complications.
10 Keep your hand up if you died.
11 Ask students who had risk factors and were infected to record their recovery time on the board so you can have them calculate an average.
12 Next ask the same questions 7 through 10 for those who did not have risk factors listed.
13 Ask students who did not have risk factors and were infected to record their recovery time on the front board and obtain an average from the data.

Table 3. Example of a table that can provided on the front board for collecting risk factor data from Example A

<table>
<thead>
<tr>
<th></th>
<th>With risk factors</th>
<th>Without risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number infected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number infected with complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number who died</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average recovery time</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Influenza Activity Example B. the effect of increased immunity on the spread of influenza in a population**

1. Now try the same demonstration with one modification. Tell the students to keep the same character card, but to turn in the “infected” and “vaccinated” cards.
2. Randomly distribute “vaccinated” cards to about 80% of the class and explain that they are a new population.
3. These vaccinated students should write down the last two digits of their social Security numbers for comparison to the Vaccine Efficacy range.
4. Give an “infected” card to one or two students in the middle of the classroom and start three or four rounds of play as completed in Example A.

**Data that should be collected for Example B**

Less data is collected in Example B. The point here is simply to collect enough data to compare the effects of increased vaccination on the population as a whole. Table 4 is a sample table that may be used for data collection. You can opt to collect all of the data as you did in the previous example (tables 2 and 3), but it takes much time and has a tendency to be redundant.
Table 4. Example of a table that can be provided on the front board for collecting data from Example B

<table>
<thead>
<tr>
<th>Total number in the population</th>
<th>Number vaccinated</th>
<th>Number infected</th>
<th>Number of infected who experienced complications</th>
<th>Number of infected who died</th>
</tr>
</thead>
</table>

**Activity wrap-up and discussion**

Students should complete a report sheet like the one provided (student version). This report sheet contains questions that can be used to guide class discussion. I typically have the students break into groups of three or four to have small group discussions using these questions as a guide. I also encourage them to generate some of their own discussion questions. After about 10 to 15 minutes, the small groups report on their discussions and help lead a class discussion. I use this time to help fill in the gaps and explain concepts such as antigenic shift and drift.

**Discussion points**

1. Why did the vaccine have less than a 100% efficacy rate? What factors lower the efficacy rate of the influenza vaccine?
2. What are some risk factors for influenza and some of the complications that can arise due to those risk factors?
3. What complications commonly arise in children?
4. If the efficacy rate of the vaccine is only 60 percent in people over age 60, then why should they bother getting vaccinated?
5. What is herd immunity? Define it. Were we able to achieve herd immunity in our demonstration? Why or why not? If not, then did we at least significantly reduce the spread of the disease?
6. What is antigenic shift? Explain the concept of antigenic shift with respect to influenza. How does antigenic shift affect the efficacy of the vaccine?
7. Why is it recommended to get a yearly influenza vaccine?
Immunity and the Spread of Influenza within a Population
Student Version

Introduction: In this activity you will observe the spread of influenza in two hypothetical populations. You will be able to observe how influenza affects individuals of different ages and with different risk factors. You will compare the spread and outcome of influenza in a population where less than 20% are vaccinated to a population where greater than 70% are vaccinated. You will play a character in these hypothetical populations, and the class will gather, analyze, and discuss data on prevalence, mortality, recovery, and vaccination rate.

Homework (complete prior to class): Try to answer these Preactivity Questions using the following websites and your textbook. Read the information provided by these websites on vaccines and influenza and try your best to answer the questions.

http://www.accessexcellence.org/AE/AEC/CC/vaccines_how_why.html (clear concise information on vaccines)

http://micro.magnet.fsu.edu/cells/viruses/influenzavirus.html (specifics about the flu virus)

http://www.cdc.gov/flu/ (a plethora of information on influenza).

http://www.cdc.gov/vaccines/ (more in-depth information on vaccines)

Preactivity Questions

1. Describe how vaccines work to make somebody immune to a disease.
2. What is herd immunity? Define it.
3. What type of virus is influenza? What type of nucleic acid does influenza have and how is the nucleic acid organized?
4. What is antigenic drift? Explain the concept of antigenic drift with respect to influenza. How does this affect the efficacy of the vaccine?
5. What is antigenic shift? Explain the concept of antigenic shift with respect to influenza. How does antigenic shift affect the efficacy of the vaccine?
6. Which strains of influenza typically infect humans?
7. What are the typical symptoms associated with influenza?
8. What are some risk factors for influenza and some of the complications that can arise due to those risk factors?
9. What complications commonly arise in children?
10. Describe all of the different ways influenza disease can be controlled in the human population.
11. What type of vaccine is the influenza vaccine (live attenuated, inactivated, subunit, or toxoid)?
12. Why is it recommended to get a yearly influenza vaccine?
13. Who should get the influenza vaccine and why should they get it? Who should not get the influenza vaccine and why?
14. What factors lower the efficacy rate of the influenza vaccine?
Influenza Activity Example A. Modeling influenza spread in a typical population

1. Obtain a character card.
2. If you have received the flu vaccine this year, then obtain a “vaccinated” card and recall the last two digits of your social security number (you will need it later). The class now represents a hypothetical population and we will model the spread of influenza.
3. With the assistance of the instructor, determine the percentage of the class who has had the influenza vaccine this year and record this on your data sheet. These folks are considered to have immunity for influenza.
4. The instructor will randomly select one or more students to become infected initially. They will receive an “infected” card. These individuals have entered your population infected with influenza.
5. Now the class will proceed through several rounds, where the following will take place:
   a. All infected individuals should reach out and randomly select one to three people sitting near them to be exposed.
   b. If you have been exposed and are not vaccinated, then you must obtain an infected card.
   c. If you have been exposed and are vaccinated, then you should look at the Vaccine Efficacy Range on your character card. If the number representing the last two digits of your social security number (SSN) falls within the vaccine efficacy range on your character card, then the vaccine was effective and you did not become infected (00 will represent the number 100). The range listed on your character card represents the chance of the vaccine being effective in your character. If your SSN does not fall within the range on your character card, then the vaccine was not effective and you have become infected. You should obtain an infected card.
   d. All students who have an infected card must reach out and randomly contact one to three people sitting near them to be exposed (at least one of those individuals should not already be infected). Next, repeat steps b through d.
6. Repeat steps a through d two more times.
7. After the fourth round, read the conclusion for your character. The instructor will help you collect the data that you will use to fill in the Report Sheet.

Influenza Activity Example B. The effect of increased immunity on the spread of influenza in a population

1. The demonstration from Influenza Activity Example A will be repeated for four rounds, however the instructor will “vaccinate” at least 70% of the population in an attempt to achieve “herd immunity.”
2. Steps 4 through 7 (above) will be repeated and you will remain as the same character, but your vaccination status may change this time.
3. Data will be gathered after the demonstration.
**Report Sheet**

**Data from Example A (where a small percentage of the population has been vaccinated)**

Percentage of the class that had received the vaccine  
(Divide the number of vaccinated individuals by the total number of students in the class and multiply by 100.)

Percentage of the class that became infected  
(Divide the number of infected individuals by the total number of students in the class and multiply by 100.)

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Percentage of infected individuals</th>
<th>Percentage of infected individuals with complications</th>
<th>Percentage of infected individuals who died</th>
<th>Average recovery time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6 mos.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 mos.–1 yr.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2–15 yrs.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>16–60 yrs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 60 yrs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2. Comparison of influenza effects on portions of a population with and without risk factors**

<table>
<thead>
<tr>
<th>Percentage of infected individuals</th>
<th>With risk factors</th>
<th>Without risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of infected individuals with complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of infected individuals who died</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average recovery time</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data from Example B (where at least 70% of the population has been vaccinated)

Percentage of the class that had the vaccine ______________________________________________________________________
(Divide the number of vaccinated individuals by the total number of students in the class and multiply by 100.)

Percentage of the class that became infected ______________________________________________________________________
(Divide the number of infected individuals by the total number of students in the class and multiply by 100.)

Percentage of the infected individuals who experienced complications________________________
(Divide the number of infected individuals who experienced complications by the total number of infected individuals and multiply by 100.)

Percentage of infected individuals who died _____________________________
(Divide the number of infected individuals who died by the total number of infected individuals and multiply by 100.)

Discussion questions

Break up into small groups of three to four people and use the following questions to guide your discussion. Your group will be asked to report your discussion to the class. Elect a spokesperson in your group and make sure you take notes on your answers to these questions.

1. Why did the vaccine have less than a 100% efficacy rate? What factors lower the efficacy rate of the influenza vaccine?
2. What are some risk factors for influenza and some of the complications that can arise due to those risk factors?
3. What complications commonly arise in children?
4. If the efficacy rate of the vaccine is only 60 percent in people over age 60, then why should they bother getting vaccinated?
5. What is herd immunity? Define it. Were we able to achieve herd immunity in our demonstration? Why or why not? If not, then did we at least significantly reduce the spread of the disease?
6. What is antigenic shift? Explain the concept of antigenic shift with respect to influenza. How does antigenic shift affect the efficacy of the vaccine?
7. Why is it recommended to get a yearly influenza vaccine?
Example Character Cards

For my class, I made a group of 102 character cards with the following specifications:

- 64 adults (nonelderly) with no risk factors
- 10 elderly
- 8 children
- 6 diabetics (2 children and 2 adults)
- 4 smokers (nonelderly adults)
- 4 with asthma (nonelderly adults)
- 4 pregnant (nonelderly adults)
- 2 HIV positive (nonelderly adults)
- 4 on immunosuppressant therapy (2 nonelderly adults and 2 elderly)

Below I have included example character cards that can be copied and cut out to create a deck of cards that represents your hypothetical population. The population I have modeled in my example above obviously has a higher rate of risk factors than you would find in any random sample of a real population. I modeled my population this way so that students could actually see how certain risk factors can cause complications in the treatment and prevention of influenza. If I attempted to mimic a real random population with a class size smaller than 100, there would not have been enough risk factors in the population to achieve the desired effect.

You can easily achieve the above population if you make

- 8 copies of page 2 (adults and nonelderly with no risk factors)
- 2 copies of page 3 (elderly)
- 1 copy of page 4 (children)
- 2 copies of page 5 (children and nonelderly adults with risk factors)
- 2 copies of page 6 (nonelderly adults with risk factors)
### Nonelderly adults with no risk factors

**Age 25 years**

**Risk Factors:** none  
**Complications:** none  
**Conclusion:** experienced fever, myalgia, headache, malaise, cough, sore throat, and rhinitis. Recovery occurred within 1 week.  
**Vaccine efficacy: 80% (range 1-80)**  
If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.

**Age 25 years**

**Risk Factors:** none  
**Complications:** none  
**Conclusion:** experienced fever, headache, malaise, cough, sore throat, and rhinitis. Recovery occurred within 2 weeks.  
**Vaccine efficacy: 80% (range 1-80)**  
If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.

**Age 36 years**

**Risk Factors:** none  
**Complications:** none  
**Conclusion:** experienced fever, myalgia, headache, malaise, cough, sore throat, and rhinitis. Recovery occurred within 2 weeks.  
**Vaccine efficacy: 80% (range 1-80)**  
If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.

**Age 18 years**

**Risk Factors:** none  
**Complications:** none  
**Conclusion:** experienced fever, myalgia, headache, malaise, cough, sore throat, and rhinitis. Recovery occurred within 1 week.  
**Vaccine efficacy: 80% (range 1-80)**  
If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.

**Age 19 years**

**Risk Factors:** none  
**Complications:** none  
**Conclusion:** experienced fever, myalgia, headache, malaise, cough, sore throat, vomiting, and rhinitis. Recovery occurred within 1.5 weeks.  
**Vaccine efficacy: 80% (range 1-80)**  
If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.

**Age 42 years**

**Risk Factors:** none  
**Complications:** none  
**Conclusion:** experienced fever, myalgia, headache, malaise, cough, sore throat, and rhinitis. Recovery occurred within 1.5 weeks.  
**Vaccine efficacy: 80% (range 1-80)**  
If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.

**Age 51 years**

**Risk Factors:** none  
**Complications:** none  
**Conclusion:** experienced fever, headache, malaise, cough, sore throat, and rhinitis. Recovery occurred within 2 weeks.  
**Vaccine efficacy: 80% (range 1-80)**  
If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.

**Age 22 years**

**Risk Factors:** none  
**Complications:** none  
**Conclusion:** experienced slight fever, headache, malaise, cough, and sore throat. Works in a clinic and received antiviral therapy during incubation period. Recovery occurred in 3 days.  
**Vaccine efficacy: 80% (range 1-80)**  
If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.
<table>
<thead>
<tr>
<th>Age 82 years</th>
<th>Age 70 years</th>
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<tbody>
<tr>
<td><strong>Risk Factors:</strong> lowered immunity, heart condition</td>
<td><strong>Risk Factors:</strong> lowered immunity, heart condition</td>
</tr>
<tr>
<td><strong>Complications:</strong> secondary infection of upper respiratory tract resulted in pneumonia.</td>
<td><strong>Complications:</strong> secondary infection of upper respiratory tract resulted in pneumonia.</td>
</tr>
<tr>
<td><strong>Conclusion:</strong> during the first week experienced fever, myalgia, headache, malaise, nonproductive cough, sore throat, fluid accumulation in lungs, and rhinitis. Diagnosed with pneumonia by second week. Admitted to hospital. Hospitalized for 1 week and fully recovered within 4 weeks.</td>
<td><strong>Conclusion:</strong> During the first week experienced fever, myalgia, headache, malaise, nonproductive cough, sore throat, fluid accumulation in lungs, and rhinitis. Diagnosed with pneumonia by second week. Admitted to hospital. Died during third week.</td>
</tr>
<tr>
<td><strong>Vaccine efficacy:</strong> 35% (range 1-35)</td>
<td><strong>Vaccine efficacy:</strong> 35% (range 1-35)</td>
</tr>
<tr>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-35, then assume that the vaccine was effective and you did not become infected with flu.</td>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-35, then assume that the vaccine was effective and you did not become infected with flu.</td>
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<thead>
<tr>
<th>Age 68 years</th>
<th>Age 65 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk Factors:</strong> lowered immunity</td>
<td><strong>Risk factors:</strong> on immunosuppressant therapy for transplanted tissue, uncontrolled diabetes, heart disease</td>
</tr>
<tr>
<td><strong>Complications:</strong> none</td>
<td><strong>Complications:</strong> pneumonia, congestive heart failure</td>
</tr>
<tr>
<td><strong>Conclusion:</strong> experienced fever, myalgia, headache, malaise, nonproductive cough, sore throat, and rhinitis. Recovery occurred within 2 weeks.</td>
<td><strong>Conclusion:</strong> experienced fever, headache, malaise, cough, accumulation of fluid in lungs, sore throat, and severe fatigue. Hospitalized after 1 week and did not recover. Died during second week.</td>
</tr>
<tr>
<td><strong>Vaccine efficacy:</strong> 35% (range 1-35)</td>
<td><strong>Vaccine efficacy:</strong> 35% (range 1-35)</td>
</tr>
<tr>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-35, then assume that the vaccine was effective and you did not become infected with flu.</td>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-35, then assume that the vaccine was effective and you did not become infected with flu.</td>
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<tr>
<th>Age 80 years</th>
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<tbody>
<tr>
<td><strong>Risk Factors:</strong> lowered immunity, heart condition</td>
<td><strong>Risk factors:</strong></td>
</tr>
<tr>
<td><strong>Complications:</strong> secondary infection of upper respiratory tract resulted in pneumonia.</td>
<td>on immunosuppressant therapy for transplanted tissue, uncontrolled diabetes, heart disease</td>
</tr>
<tr>
<td><strong>Conclusion:</strong> during the first week experienced fever, myalgia, headache, malaise, nonproductive cough, sore throat, fluid accumulation in lungs, and rhinitis. Diagnosed with pneumonia by second week. Admitted to hospital. Recovered after 6 weeks.</td>
<td><strong>Complications:</strong> pneumonia, congestive heart failure</td>
</tr>
<tr>
<td><strong>Vaccine efficacy:</strong> 35% (range 1-35)</td>
<td><strong>Conclusion:</strong> experienced fever, headache, malaise, cough, accumulation of fluid in lungs, sore throat, and severe fatigue. Hospitalized after 1 week and did not recover. Died during second week.</td>
</tr>
<tr>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-35, then assume that the vaccine was effective and you did not become infected with flu.</td>
<td><strong>Vaccine efficacy:</strong> 35% (range 1-35)</td>
</tr>
<tr>
<td>.</td>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-35, then assume that the vaccine was effective and you did not become infected with flu.</td>
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<tr>
<td>Age 4 years</td>
<td>Age 6 years</td>
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</tr>
<tr>
<td><strong>Risk Factors:</strong> none</td>
<td><strong>Risk Factors:</strong> diabetes (controlled)</td>
</tr>
<tr>
<td><strong>Complications:</strong> otitis media</td>
<td><strong>Complications:</strong> otitis media</td>
</tr>
<tr>
<td><strong>Conclusion:</strong> experienced fever, sore throat, cough, malaise, vomiting, and severe congestion. Developed otitis media in the second week. Recovered from flu within 1 week, but required antibiotic therapy for middle ear infection. Eventually required ear tube surgery (tympanostomy tubes) and fully recovered hearing.</td>
<td><strong>Conclusion:</strong> experienced fever, sore throat, cough, malaise, ear infection, and severe congestion. Recovered within 2 weeks.</td>
</tr>
<tr>
<td><strong>Vaccine efficacy: 84% (range 1-84)</strong> If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-84, then assume that the vaccine was effective and you did not become infected with flu.</td>
<td><strong>Vaccine efficacy: 84% (range 1-84)</strong> If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-84, then assume that the vaccine was effective and you did not become infected with flu.</td>
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<table>
<thead>
<tr>
<th>Age 5 years</th>
<th>Age 3 months</th>
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</thead>
<tbody>
<tr>
<td><strong>Risk Factors:</strong> diabetes (controlled)</td>
<td><strong>Risk Factors:</strong> weakened immunity</td>
</tr>
<tr>
<td><strong>Complications:</strong> none</td>
<td><strong>Complications:</strong> extremely high fever, febrile seizures</td>
</tr>
<tr>
<td><strong>Conclusion:</strong> experienced fever, sore throat, cough, malaise, vomiting, and severe congestion. Recovered within 1.5 weeks.</td>
<td><strong>Conclusion:</strong> experienced extreme fever, fatigue, cough, rhinitis, vomiting, and febrile seizures. Admitted to the emergency room during the first week for seizures. Recovery occurred within 3 weeks.</td>
</tr>
<tr>
<td><strong>Vaccine efficacy: 84% (range 1-84)</strong> If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-84, then assume that the vaccine was effective and you did not become infected with flu.</td>
<td><strong>Vaccine not given. Your character was not given the vaccine since he/she is under the age of 6 months.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age 12 months</th>
<th>Age 5 months</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk Factors:</strong> none</td>
<td><strong>Risk Factors:</strong> weakened immunity</td>
</tr>
<tr>
<td><strong>Complications:</strong> extremely high fever, febrile seizures</td>
<td><strong>Complications:</strong> extremely high fever, febrile seizures</td>
</tr>
<tr>
<td><strong>Conclusion:</strong> experienced extreme fever, fatigue, cough, rhinitis, vomiting, and febrile seizures. Admitted to the emergency room during the first week for seizures. Recovery occurred within 3 weeks. Suffers from reoccurring seizures.</td>
<td><strong>Conclusion:</strong> experienced extreme fever, fatigue, cough, rhinitis, and febrile seizures. Admitted to the emergency room during the first week for seizures and an injury due to the seizures that resulted in a concussion. Hospitalized for 2 days. Recovery occurred within 4 weeks.</td>
</tr>
<tr>
<td><strong>Vaccine efficacy: 58% (range 1-58)</strong> If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-58, then assume that the vaccine was effective and you did not become infected with flu.</td>
<td><strong>Vaccine not given. Your character was not given the vaccine since he/she is under the age of 6 months.</strong></td>
</tr>
</tbody>
</table>
### Age 12 months

**Risk Factors:** none  
**Complications:** extremely high fever, febrile seizures  
**Conclusion:** experienced extreme fever, fatigue, cough, rhinitis, sore throat, and febrile seizures. Admitted to the emergency room during first week for seizures. Recovery occurred within 3 weeks.

**Vaccine efficacy: 58% (range 1-58)**

If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-58, then assume that the vaccine was effective and you did not become infected with flu.

### Nonelderly adults with risk factors

#### Age 32 years

**Risk Factors:** asthma  
**Complications:** increased episodes of wheezing, breathlessness, and chest tightness  
**Conclusion:** experienced fever, headache, malaise, nonproductive cough, wheezing, breathlessness, sore throat, and rhinitis. Had to visit the clinic for more effective medication to control asthma symptoms. Recovery occurred within 2.5 weeks.

**Vaccine efficacy: 80% (range 1-80)**

If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.

#### Age 41 years

**Risk Factors:** chemotherapy for breast cancer  
**Complications:** pneumonia  
**Conclusions:** experienced fever, vomiting, weight loss, headache, malaise, cough, fluid accumulation in lungs, sore throat, and rhinitis. Hospitalized for 5 days. Recovery after 4 weeks.

**Vaccine efficacy: 48% (range 1-48)**

If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-48, then assume that the vaccine was effective and you did not become infected with flu.

#### Age 45 years

**Risk Factors:** asthma  
**Complications:** increased episodes of wheezing, breathlessness, and chest tightness  
**Conclusion:** experienced fever, myalgia, headache, malaise, nonproductive cough, wheezing, severe breathlessness, sore throat, and rhinitis. Failed to treat asthma effectively. Died from severe asthma attack during second week of disease.

**Vaccine efficacy: 80% (range 1-80)**

If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.

#### Age 55 years

**Risk Factors:** smoker  
**Complications:** increased congestion and longer recovery  
**Conclusion:** experienced fever, myalgia, headache, malaise, cough, sore throat, fluid accumulation in lungs, wheezing, difficulty breathing, and rhinitis. Neglected to stop smoking. Recovery occurred within 6 weeks. Visited the clinic for supportive therapy.

**Vaccine efficacy: 80% (range 1-80)**

If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.
<table>
<thead>
<tr>
<th>Age</th>
<th>Risk Factors</th>
<th>Complications</th>
<th>Conclusion</th>
<th>Vaccine efficacy: 80% (range 1-80)</th>
<th>Vaccine efficacy: 48% (range 1-48)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 years</td>
<td>smoker.</td>
<td>increased episodes of wheezing, breathlessness, and chest tightness. Patient is a smoker and neglected to stop smoking.</td>
<td>experienced fever, headache, malaise, nonproductive cough, wheezing, breathlessness, sore throat, and rhinitis. Visited the clinic during second week and received drug therapy for symptoms only. Recovery occurred within 3 to 4 weeks.</td>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.</td>
<td></td>
</tr>
<tr>
<td>38 years</td>
<td>HIV AIDS</td>
<td>pneumonia</td>
<td>experienced fever, vomiting, weight loss, headache, malaise, severe cough, fluid accumulation in the lungs, sore throat, and rhinitis. Admitted to the hospital during the first week and diagnosed with pneumonia. Hospitalized for 2 weeks. Recovery occurred after 6 weeks.</td>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-48, then assume that the vaccine was effective and you did not become infected with flu.</td>
<td></td>
</tr>
<tr>
<td>45 years</td>
<td>diabetes (uncontrolled)</td>
<td>onset of pneumonia during second week</td>
<td>experienced fever, malaise, severe cough, rhinitis, sore throat, and fluid accumulation in the lungs. Hospitalized and died during the second week from pneumonia.</td>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-48, then assume that the vaccine was effective and you did not become infected with flu.</td>
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</tr>
<tr>
<td>33 years</td>
<td>diabetes (uncontrolled)</td>
<td>none</td>
<td>experienced fever, malaise, severe cough, rhinitis, sore throat, and some fluid accumulation in the lungs. Recovered within 3 to 4 weeks.</td>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-48, then assume that the vaccine was effective and you did not become infected with flu.</td>
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</tr>
<tr>
<td>28 years</td>
<td>24 weeks pregnant</td>
<td>high fever</td>
<td>experienced high fever, severe malaise, nonproductive cough, sore throat, congestion, vomiting, and rhinitis. Experienced difficulty controlling symptoms because few medications are safe for pregnant women. Lost 10 pounds. Recovery occurred within 4 to 5 weeks. No complications with delivery and child appeared healthy.</td>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.</td>
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<tr>
<td>35 years</td>
<td>10 weeks pregnant</td>
<td>high fever</td>
<td>experienced high fever, severe malaise, nonproductive cough, sore throat, congestion, vomiting, and rhinitis. Experienced difficulty controlling symptoms because few medications are safe for pregnant women. Recovery occurred within 4 to 5 weeks. Miscarriage occurred.</td>
<td>If you are exposed and were vaccinated and the last two digits of your SSN fall within the range of numbers 1-80, then assume that the vaccine was effective and you did not become infected with flu.</td>
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</tbody>
</table>
**Vaccine Cards.** These cards serve to remind students if they have been vaccinated during the two rounds of the activity. During the first round, I typically give the students a vaccinated card only if they were vaccinated for influenza during the current or previous flu season. During the second round, I randomly select about 70 to 80% of the students in the class to be vaccinated. You will need to have enough cards for about 80% of your class.

<table>
<thead>
<tr>
<th>Vaccinated</th>
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</table>
**Infection Cards—to be given to students when they are infected.**
Since the activity can become chaotic, these cards serve as a useful reminder to the students who become infected. If the cards are printed on red paper, then these cards also produce a neat visual effect when many are infected. The infected students should display the card on the desk in front of themselves. You will need approximately one card per student.

<table>
<thead>
<tr>
<th>INFECTED</th>
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<tbody>
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Preactivity Questions

1. Describe how vaccines work to make somebody immune to a disease.
   
   A vaccine is the introduction of antigens from a pathogen (usually by injection) to a host. The antigens can be pieces from the pathogen, dead pathogen, or a live pathogen that has been weakened and unable to cause the actual disease. When a person is injected with these antigens, his/her immune system produces memory cells that can bind to, and illicit an attack on, that specific antigen. These cells create immunity or a defense against that antigen if the person comes into contact with it again.

2. What is herd immunity? Define it.
   
   Herd immunity is when a significant percentage (>70%, usually) of a population is immune to a given disease. This causes a dramatic decrease in the spread of that disease. Even individuals who are not immune experience some level of protection since the spread of the disease is limited.

3. What type of virus is influenza? What type of nucleic acid does it have and how is the nucleic acid organized?
   
   Influenza is a segmented single-stranded RNA virus. It has eight segments of single-strand RNA.

4. What is antigenic drift? Explain the concept of antigenic drift with respect to influenza. How does this affect the efficacy of the vaccine?
   
   Antigenic drift occurs due to the natural mutation rate of the virus. When the viral RNA is replicated mistakes are made, which result in mutation. These mutations are likely to change some of the expressed antigens on the surface of the virus. Over time, one would expect to see small changes in the surface antigens. When a vaccine is given during a flu season, it contains strains of influenza that were predicted to be circulating in the population during that year. Antigenic drift can cause the strains to change within a population over time, thus making the previous vaccine ineffective.

5. What is antigenic shift? Explain the concept of antigenic shift with respect to influenza. How does antigenic shift affect the efficacy of the vaccine?
   
   Antigenic shift occurs when two viruses that have different surface antigens invade the same organism and exchange segments of genetic information. This genetic reassortment often results in a new strain with a different combination of surface antigens. Antigenic shift can cause abrupt changes in the strains of the virus that are circulating within a population. When vaccine is given during a flu season, it contains strains of influenza that were predicted to be circulating in the population during that year. Antigenic shift can cause the strains to change within a population in a relatively short amount of time, thus making the previous vaccine ineffective.

6. Which strains of influenza typically infect humans?
   
   Of the three general types of strains, influenza A and B strains can cause epidemic diseases. Influenza C type strain typically doesn’t cause disease.
7. What are the typical symptoms associated with influenza?
Fever, headache, extreme tiredness, dry cough, sore throat, runny or stuffy nose, and muscle aches are most common. Children can have additional gastrointestinal symptoms and secondary ear infections.

8. What are some risk factors for influenza and some of the complications that can arise due to those risk factors?
Risk factors that can more easily lead to complications include: compromised immune system (due to disease or age of individual), asthma, diabetes, heart disease, and epilepsy.

Complications include: dehydration and secondary infections such as pneumonia, otitis media, and sinus infections. Sometimes chronic medical problems can worsen, such as congestive heart failure, asthma, or diabetes (uncontrolled blood sugars).

9. What complications commonly arise in children?
Febrile seizures, earaches, and dehydration are common in children.

10. Describe all of the different ways influenza disease can be controlled in the human population.
Hand washing, vaccination, keeping infected individuals at home (not in public), using antiviral drugs, avoiding close contact with obviously sick individuals, covering mouth and nose, and avoiding touching of eyes, nose, and mouth.

11. What type of vaccine is the influenza vaccine (live attenuated, inactivated, subunit, or toxoid)?
There are two types of influenza vaccine. The vaccine that is most common and is injectable is the inactivated vaccine. The vaccine that is less common and is given intranasally is a live attenuated vaccine.

12. Why is it recommended to get a yearly influenza vaccination?
The strains of influenza circulating in the population change periodically due to genetic changes over time (antigenic shift and drift). The strains circulating this year are likely to be different than those circulating next year. The vaccine is only effective against the strains for which it was created.

13. Who should get the influenza vaccine and why? Who should not get the influenza vaccine and why?
Most folks should get the influenza vaccine to prevent spread of the disease. Some folks should especially get it. Individuals who fall into any of the following groups are highly recommended by the Centers for Disease Control and Prevention to get the vaccine: those with diseases that are likely to lead to complications (e.g., diabetes, asthma, sickle cell anemia, AIDS, heart disease) and those who care for individuals with diseases that are likely to lead to complications, pregnant women, children between 6 months and 5 years old, and elderly individuals (especially those in assisted living). People who are allergic to eggs should not get the vaccine due to the risk of a severe allergic reaction.
14. What factors lower the efficacy rate of the influenza vaccine?
   • Ability of the immune system to respond to the vaccine.
   • Age: children under 6 months old and adults over age 65 do not produce a strong response.
   • Diseases that affect the immune system.
   • Taking a vaccine with the “wrong” strains of influenza—the strains that are not circulating in the population.

Report Sheet

Discussion Questions

1. Why did the vaccine have less than a 100% efficacy rate? What factors lower the efficacy rate of the influenza vaccine?
   The virus changes over time due to antigenic shift and antigenic drift. Also, some people have diseases or conditions that decrease the efficacy of the vaccine.

2. What are some risk factors for influenza and some of the complications that can arise due to those risk factors?
   Risk factors that can more easily lead to complications include: compromised immune system (due to disease or age of individual), asthma, diabetes, heart disease, and epilepsy.

Complications include: dehydration and secondary infections such as pneumonia, otitis media, and sinus infections. Sometimes chronic medical problems can worsen, such as congestive heart failure, asthma, or diabetes (uncontrolled blood sugars).

3. What complications commonly arise in children?
   Febrile seizures, earaches, and dehydration are common in children.

4. If the efficacy rate of the vaccine is only 60 percent in people over age 60, then why should they bother getting vaccinated?
   Elderly individuals are far more likely to experience complications from influenza infections. These complications can lead to hospitalization and death. Elderly folks take much longer to recover from flu. It is important to protect them even if the vaccine is less likely to be effective.

5. What is herd immunity? Define it. Were we able to achieve herd immunity in our demonstration? Why or why not? If not, then did we at least significantly reduce the spread of the disease?
   Herd immunity is when a significant percentage (>70%, usually) of a population is immune to a given disease. This causes a dramatic decrease in the spread of that disease. Even individuals who are not immune experience some level of protection since the spread of the disease is limited.
Answers will vary for achieving herd immunity. However, students should understand that the spread of the disease was reduced significantly with an increase in vaccination rate.

6. What is antigenic shift? Explain the concept of antigenic shift with respect to influenza. How does antigenic shift affect the efficacy of the vaccine?

Antigenic shift occurs when two viruses that have different surface antigens invade the same organism and exchange segments of genetic information. This genetic reassortment often results in a new strain with a different combination of surface antigens. Antigenic shift can cause abrupt changes in the strains of the virus that are circulating within a population. When vaccine is given during a flu season, it contains strains of influenza that were predicted to be circulating in the population during that year. Antigenic shift can cause the strains to change within a population in a relatively short amount of time, thus making the previous vaccine ineffective.

7. Why is it recommended to get a yearly influenza vaccine?
The strains circulating in the population change periodically due to genetic changes over time (antigenic shift and drift). The strains circulating this year are likely to be different than those circulating next year. The vaccine is only effective against the strains for which it was created.
Examples of applicable questions that can be used on pre- and postquizzes.

1. One hundred percent of a population must be vaccinated against influenza in order to see reduced spread of the disease in the population. True or False
   __False_________

2. If you get the influenza vaccine, there is a 0% chance that you will get the flu during the year. True or False ______False_________

3. If you got the influenza vaccine last year, you are still not likely to get influenza this year. True or False _________False______

4. Influenza vaccine is defined as (choose one and circle)
   a. an injection of a chemical that helps you recover from influenza much faster
   b. an injection of immunoglobulin-containing antibodies that fight influenza virus
   c. an injection of an actual part of the influenza virus that stimulates an immune response that can protect you from infection
   d. an antibiotic that fights influenza infection

   ANS: C

5. What percentage of a typical population of college students gets the flu vaccine? (choose one and circle)
   a. 0%
   b. 100%
   c. 70%
   d. 5%

   ANS: D

6. Which of the following is/are true? (choose one and circle)
   a. Some people are more susceptible to influenza than others.
   b. Some people experience many complications from the flu, which can lead to death.
   c. If a large enough percentage of a population receives the influenza vaccine, the spread of the flu in that population can be greatly reduced.
   d. All of the above are true.

   ANS: D

7. What are you injected with when you get the flu vaccine? (choose one and circle)
   a. live influenza virus
   b. a portion of a dead influenza virus
   c. antibodies
   d. antibiotics

   ANS: B (NOTE: Live attenuated vaccines are used too, but these are not typically injected. They are given intranasally)
8. Approximately what percentage of a population needs to be vaccinated in order to achieve herd immunity? (choose one and circle)
   a. 100%
   b. 70%
   c. 50%
   d. 10%
ANS: B

9. Why do you have to get a new flu shot every year? (choose one and circle)
   a. Because the shot you got last year is old and doesn’t work any more.
   b. Because each year there are potentially new strains of the virus that can infect you.
   c. Because the vaccine is improved every single year.
   d. So you can get used to being injected.
ANS: B

10. While it is a good idea for most people to get the influenza vaccine, who SHOULD get the influenza vaccine? List at least two examples where it is especially important for the person to get the influenza vaccine.

   Answers may include:
   Diabetics, Elderly, children especially between the ages of 6 months to 5 years, People who are at high risk for getting complications from influenza and people who care for people who are at high risk for complications, pregnant women, people with certain chronic medical conditions.

11. Why do you have to get a new flu shot every year?
Each year the influenza strains that are circulating amongst human populations change. These changes are due to antigenic shift (abrupt changes in surface antigens on the virus as the result of genetic reassortment) and antigenic drift (gradual changes in the surface antigens on the virus as a result of mutation). Because of the changes in strains the vaccine given during a previous year is not likely to be effective against the surface antigens found on the new viral strains that are likely to be circulating in subsequent years.

12. Explain how antigenic shift influences the efficacy of an influenza vaccine.
Antigenic shift occurs when two viruses that have different surface antigens invade the same organism and they exchange segments of genetic information. This genetic reassortment often results in a new strain with a different combination of surface antigens. Antigenic shift can cause abrupt changes in the strains of the virus that are circulating within a population. When vaccine is given during a flu season this vaccine contains strains of influenza that were predicted to be circulating in the population during that year. Antigenic shift can cause the strains to change within a population in a relatively short amount of time; thus, making the previous vaccine ineffective.
Examples of applicable questions that can be used on pre- and postquizzes.

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2. If you get the influenza vaccine, there is a 0% chance that you will get the flu during the year. True or False ______False__________

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   a. an injection of a chemical that helps you recover from influenza much faster
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ANS: C

5. What percentage of a typical population of college students gets the flu vaccine? (choose one and circle)
   a. 0%
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   d. 5%

ANS: D

6. Which of the following is/are true? (choose one and circle)
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   b. Some people experience many complications from the flu, which can lead to death.
   c. If a large enough percentage of a population receives the influenza vaccine, the spread of the flu in that population can be greatly reduced.
   d. All of the above are true.

ANS: D

7. What are you injected with when you get the flu vaccine? (choose one and circle)
   a. live influenza virus
   b. a portion of a dead influenza virus
   c. antibodies
   d. antibiotics

ANS: B (NOTE: Live attenuated vaccines are used too, but these are not typically injected. They are given intranasally)
8. Approximately what percentage of a population needs to be vaccinated in order to achieve herd immunity? (choose one and circle)
   a. 100%
   b. 70%
   c. 50%
   d. 10%

ANS: B

9. Why do you have to get a new flu shot every year? (choose one and circle)
   a. Because the shot you got last year is old and doesn’t work any more.
   b. Because each year there are potentially new strains of the virus that can infect you.
   c. Because the vaccine is improved every single year.
   d. So you can get used to being injected.

ANS: B

10. While it is a good idea for most people to get the influenza vaccine, who SHOULD get the influenza vaccine? List at least two examples where it is especially important for the person to get the influenza vaccine.

Answers may include:
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I really enjoy the activity. From this activity, I have a better understanding of the disease and how the immune system works to prevent the body from getting infected while I have fun.

I think that this assignment was very helpful. Especially giving us material to study for a week in advance with specific objectives you want us to focus on. I don’t think I would have been able to answer the questions totally if you had not given us a quick over the material (something that will definitely ensure that everyone in the class will look into, especially if bodies points are involved).

As for this activity, I think that it was great. It was a good idea to get us all involved and the concepts really stick with us.

I think it should be used in your future classes because of how helpful it was. I like the fact that it only took to rounds for us to see the results of a small amount of people being vaccinated versus a larger amount that would attempt to represent herd immunity and how it works.

I loved the activity!

It helped a lot to understand “herd” immunity.

I enjoyed the activity. It is a creative way to apply a real world situation to the classroom. It helped put the information about the virus in my long time memory & it also helped me understand the more factors & complications associated with the flu. This activity must be performed with a cooperative class in order
I really enjoy this activity because it was fun, but it was a learning experience. It helped me understand more about the flu virus because I am a visual learner and now I understand the process, calculation, and why it is so important to get the vaccine.

Thanks!!

p.s. you are a great teacher!!

NOTE:

I liked this activity. It was very informative and interesting. It got a bit confusing because we collected our data in numbers and had to then convert it to percentages and it created confusion. This was because we had to figure out what percentage to use for the different columns. Overall it was a great activity.

I enjoyed the activity. It allowed me to learn hands-on. It should definitely be done again.

This was an interesting activity. I learned a lot about how the vaccine works and how it can significantly reduce the amount of people that get infected. I would recommend that this activity be played with a lot more people (as we were missing some of our demographics).

Overall, an excellent game.

I did learn from this lab, but the results went as expected, based for the most part on stuff I already knew. It was a little hectic getting information on the board. The activity was fun for something different!!

I enjoyed this activity a lot and having to participate in the demonstration helped me to learn and understand the way it works in real life.
Report Sheet

Data from Example A (Where a small percentage has been vaccinated)

Percent of the class that had the vaccine ___8%___

Percent of the class that became infected ___92%___

Table 1. Influenza data for various age groups within the population.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>0-6 months</th>
<th>6-24 months</th>
<th>2-15 years</th>
<th>16-60 years</th>
<th>&gt; 60 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage Infected</td>
<td>100%</td>
<td>0</td>
<td>50%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Percentage with Complications</td>
<td>100%</td>
<td>0</td>
<td>0%</td>
<td>46.7%</td>
<td>100%</td>
</tr>
<tr>
<td>Mortality Rate</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
<td>13.3%</td>
<td>20%</td>
</tr>
<tr>
<td>Average Recovery Time</td>
<td>3 weeks</td>
<td>0</td>
<td>1.75 weeks</td>
<td>2.7 weeks</td>
<td>4.5 weeks</td>
</tr>
</tbody>
</table>

Table 2. Comparison of influenza effects on portions of a population with and without risk factors.

<table>
<thead>
<tr>
<th></th>
<th>With risk factors</th>
<th>Without risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage Infected</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Percentage with Complications</td>
<td>90.9%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Mortality Rate</td>
<td>27.3%</td>
<td>0%</td>
</tr>
<tr>
<td>Average Recovery Time</td>
<td>3.7 weeks</td>
<td>2.38 weeks</td>
</tr>
</tbody>
</table>

Data from Example B (Where at least 70% of the population has been vaccinated)

Percentage of the class that had the vaccine ___70%___

Percentage of the class that became infected ___36%___

Percentage of class with complications ___66.7%___

Mortality Rate ___22%___

Discussion Questions:
1. Why did the vaccine have less than 100% efficacy rate? What factors lower the efficacy rate of the influenza vaccine?
Introductory Microbiology

Influenza Activity

- The vaccine did not have a 100% efficacy rate because the vaccinated person might encounter a different strain of the virus. Age and other risk factors along with the mutations of the flu lower the efficacy rate of the influenza vaccine.

2. What are some risk factors for influenza and some of the complications that can arise due to those risk factors?
   - Some risk factors include ineffective immune system due to extremely young or old age, having a weak pulmonary defense system due to smoking, uncontrolled diabetes, asthma, pregnancy, heart disease, or if someone is undergoing immunosuppressant therapy. These risk factors may lead to complications such as pneumonia caused by the accumulation of fluid in the lungs, breathlessness and wheezing, vomiting and weight loss, or severe fever. Many of these are caused by infectious bacteria taking advantage of the weakened immune system.

3. What complications commonly arise in children?
   - Some complications that commonly arise in children include febrile seizures with high fever, vomiting, ear and sinus infections, and dehydration.

4. If the efficacy rate of the vaccine is only 60 percent in people over 60 then why should they bother taking the vaccine?
   - They should still get vaccinated because if they were to be exposed to the virus, they would have a 60 percent chance of not being infected. If they were not vaccinated, exposure to the virus would almost definitely get them sick. People over 60 are likely to have complications that can be very serious. Therefore, they should take every precaution possible to prevent getting the flu.

5. What is herd immunity (define it)? Were we able to achieve herd immunity in our demonstration? Why or why not? If not, then did we at least significantly reduce the spread of the disease?
   - Herd immunity is the immunity that occurs when an entire group of animals or people become immune to a particular infection by vaccinating most of the population. We were not able to achieve herd immunity in the demonstration because we were always in close contact with one another and the ability of the influenza virus to spread so easily and rapidly. We were able to significantly reduce the spread of the disease because most of the vaccinated people did not get sick.

6. What is antigenic shift? Explain the concept of antigenic shift with respect to influenza. How does antigenic shift affect the efficacy of the vaccine?
   - Antigenic shift is the sudden change in antigenicity that is caused by the recombination of the genome. Antigenic shift occurs in influenza when more than one strain of the virus infects a common host. During recombination, the segments of the two viral RNA strands get mixed together to create a completely new type of virus. This new strand of the influenza lowers the efficacy of the vaccine with its unique antigens because it is likely to appear unrecognizable to the memory cells made when someone is vaccinated.

7. Why is it recommended to get a yearly influenza vaccine?
   - Getting yearly influenza vaccine will significantly lower the chance of you getting sick from the flu virus. This in turn will help to reduce the spread of the flu using the protection of herd immunity as well as lower the chance of antigenic shift to take place.