Executive Summary For Teachable Unit

I. Title: What Makes a Pandemic?

II. Developer: Pat Schloss

III. Learning goals

- *Primary* learning goals
  - Learn about pandemics that have occurred during the last century
  - Be able to discuss epidemiological issues using basic terms
  - Understand the factors involved in the persistence of a disease

- *Secondary* learning goals
  - Be anxious to learn more about viruses and their treatment/prevention
  - Appreciate that events around the world affect them [students]

IV. Scientific teaching themes: See TU Review Rubric for guidelines.

Describe how the unit addresses the following themes:

- **Scientific teaching**
  - The class will emphasize scientific approaches including data collection and visualization, discussion of case studies, and asking "what if?"-type questions.
  - The class will be taught scientifically by using carefully chosen assessment questions, allowing the students to take control of a second simulation, and by identifying the areas of confusion, which will be addressed in more detail during the second and third classes.

- **Diversity**
  - Students will have small-group discussions at the beginning of class, which should elicit the responses of those students that will not volunteer answers in front of a classroom. Also, the teacher will ask the class what types of attitudes we might have to the initial sick person if we knew who they were.

- **Active learning**
  - Students will engage in active learning while in small group discussions that start the class and during the flash card simulation.

- **Assessment**
  - The teacher will be able to judge the caliber of students and their *a priori* knowledge in the initial discussion-oriented activity. Also, the in class worksheets and homework activity will measure class participation and ability to apply ideas to other situations.

V. Teaching Plan

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Time	Topic	Activity/ Assessment	Goals
0-15	Course Introduction	*Introductions*	Set ground rules, describe rubric, etc.
15-20	Prior knowledge	*Pre-quiz*	Assess prior knowledge
20-35	Motivation	*Small group discussions of case studies and reporting of decisions and questions*	Show students that events on the other side of the world affect them
35-45	History lesson	*Mini-lecture*	Impress upon students that diseases are world-wide and the flu can kill
45-55	Gross description of the flu	*Mini-lecture*	Tell them what having the flu looks like
55-75	Epidemiological modeling	*Flashcard activity*	Get students to appreciate the factors that are involved in the spread of a disease

Teaching Plan

VI. Instructions/materials for implementation of this unit

Pre-Quiz (5 minutes): This pre-quiz will be given during class on the first day.

1) What would you do if you had flu-like symptoms?

2) Are you afraid of an imminent flu pandemic?

3) What is the difference between an epidemic and a pandemic?

4) Give two factors that give rise to an epidemic.

5) Why do pandemics occur?

Lecture Notes

Pre-quiz (5 minutes): see above

State learning goals for class (1 min) – Put up first PowerPoint slide and leave it there

Motivation (15 minutes)
Break class into four groups with 4-5 students each. Within each group, have the students consider the following hypothetical case study (Hand out slips of paper with one of the following to each group):

> *Catherine, a UW-Madison student, has returned from completing a semester abroad in Thailand where she was learning about traditional agricultural practices. After returning, she has the classic symptoms of the flu for two days: fever, body aches, vomiting, and fatigue. You are her RA, what do you do? What questions do you want to ask?*

> *Catherine, a UW-Madison student, has returned from completing a semester abroad in Thailand where she was learning about traditional agricultural practices. After returning, she has the classic symptoms of the flu: fever, body aches, vomiting, and fatigue. Her RA has called you, the State Public Health Lab, to ask for guidance. What do you do? What questions do you want to ask?*

> *Chay, a UW-Madison student, has returned from visiting his family in Thailand. After returning, he has the classic symptoms of the flu: fever, body aches, vomiting, and fatigue. You are his RA, what do you do? What questions do you want to ask?*

Teaching Plan

Chay, a UW-Madison student, has returned from visiting his family in Thailand. After returning, he has the classic symptoms of the flu: fever, body aches, vomiting, and fatigue. His RA has called you, the State Public Health Lab, to ask for guidance. What do you do? What questions do you want to ask?

Have students discuss among themselves for 3 minutes their respective case studies. Each group should first describe the case study to the class, their plan of action, and give several questions that they might ask.

Things to be prepared for:

- "Do nothing" – what are the risks of not reacting and overreacting
- Differences in reactions between Catherine and Chay – should we profile people when they have a disease or should we treat them equally?
- Differences in reactions between the RA and SHL representatives

Summary for this section of class (script):
The next three classes will address the historical and potential impact and biology of influenza. As many of you know, the H5N1 influenza is feared to soon become a pandemic, which could kill millions of people around the world. In recent weeks it has been found in Turkey, Iraq, and as far west as Italy. It is important to understand the spread, biology, and virulence of this microbe, a virus. Although, human-to-human transmission of H5N1 has not been confirmed, it is important to understand historical outbreaks to prepare for a possible pandemic.

History Lesson (10 min)

1. [write on chalk board] **Epidemic: occurs when more than the expected number of cases of disease occurring in a community or region during a given period of time.**

   Influenza epidemics occur when there is a slight genetic change in the circulating population of influenza, leading to a change in the physical appearance of the virus. This change is termed **antigenic drift**. Because the change is slight, most of the population may already have resistance and its spread will probably be contained. *Note:* it is important to introduce the term antigenic drift, write it with the definition of epidemic.

2. [write on chalk board] **Pandemic - an epidemic that becomes very widespread and affects a whole region, a continent, or the world.**

   Influenza pandemics occur when there is a significant genetic change - termed **antigenetic shift** - in the circulating population of influenza. Because of this genetic shift, a large portion of the human population is entirely vulnerable to infection from the new pandemic strain. *Note:* it is important to introduce the term antigenic shift, write it with the definition of pandemic.

Teaching Plan

Motivate this discussion by showing the average life expectancy of an American during the 20th century, ask them to explain the different dips in the trend [**Slide2**]. Note: The US casualties from WWI itself were 116,000.

History of 20th century pandemics (http://www.globalsecurity.org/security/ops/hsc-scen-3_pandemic-influenza.htm)
[Slide 3] 1918 Spanish Flu – Spain had nothing to do with the pandemic – they were neutral in WWI and had an uncensored media and were the only ones reporting on the flu. Thought that soldiers coming home from WWI spread the virus leading to at least 40 million deaths worldwide and about 500,000 people in the US. 20-40% of the world population became ill because of the pandemic. Because of a national quarantine, Western Samoa and Iceland avoided the 1918 flu.

[Slide 4] 1957 Asian Flu – Occurred in 1957, the global death toll was estimated to be around 2 million and about 70,000 deaths in the United States. In US, students and young adults were most at risk because they were commonly in crowded situations, which helped to spread the disease. Vaccine production started 3 months after initial Asian outbreaks.

[Slide 5] 1968 Hong Kong Flu - Occurred in 1968 with the Hong Kong Flu (H3N2) outbreak, which resulted in nearly 34,000 deaths in the United States and is thought to have caused around 1 million deaths worldwide. Vaccine became available one month after the initial outbreak.

Questions to ask:

- Were these the only years that people got the flu? (No, epidemics occurred as normal in the intervening years)

- Was it **antigenic drift** or **antigenic shift** that led to the 1918, 1957, and 1968 pandemics? (Antigenic shift, none of the population had immunity to these years' flu strains.)

Point out that vaccine accessibility has become more immediate and that mortality has decreased.

Other things to mention: The Spanish flu mortality was partially due to secondary infections by bacteria. During later pandemics, antibiotics were used to counter these secondary infections, and general medical care had improved.

[Slide 6] Avian Influenza – 160 humans infected, ~80 dead, spreading from East Asia to Europe. Millions of birds dead, only transmissible from birds to humans right now. Because of the large number of birds that have died and the mortality rate of those individuals that get sick, our fear is that the flu will become transmissible between humans.

[Slide 7] According to the US Department of Health & Human Services, if either the 1918 or 1957/1968 flu hit the US today, then ~90 million (of 295 million) people would be infected. The 1918 virus would kill 1.9 million and the 1957/1968 virus would kill 200,000 people. The Department of Homeland Security predicts that each would cost at least $203 and $87 billion.

[turn off PowerPoint]

Gross Description of Influenza (10 minutes) - Taken from UW UHS Fact Sheet, get brochures from UWHS. Hand out flu brochures from UW UHS. I would somewhat quickly go through the symptoms, prevention, and treatment. If you can keep this as short as possible then there will be more time for the in class simulation.

What are the symptoms?
Influenza typically begins with sudden onset of high fever (above 101°F), chills, muscle aches, headache, fatigue, and dry cough. Many people also experience a sore throat and runny nose. Although loss of appetite may occur, the influenza virus does not usually cause gastrointestinal symptoms such as vomiting or diarrhea. Severe symptoms usually last three to seven days, although cough and fatigue may persist for several weeks.

Those individuals that have contracted the virus have died because the body's fight against the attack is so violent that the lungs fill with fluid and the patient essentially drowns.

How is influenza spread?
The influenza virus is spread through secretions from the nose and throat of currently ill people. The period of infectiousness is about six days, starting a day before symptoms begin. Children can be infectious for more than ten days. The incubation period (the amount of time between exposure to the virus and the beginning of symptoms) is 24 to 96 hours. Washing hands before touching the eyes, nose or mouth can help to decrease the chance of acquiring influenza.

General treatment and prevention measures

- Rest in bed during the acute stages.
- Avoid contact with others.
- Refrain from smoking. Smoking irritates inflamed nasal passages and irritates the cilia, which clear mucus from the lungs.
- Do not overdress. Wear only enough clothing to not to be chilled.
- Drink at least 2 to 3 quarts of fluid every 24 hours while symptoms last.
- Increase environmental humidity through the use of a vaporizer or humidifier.
- A lukewarm bath or shower can help reduce fever.
- Avoid multi-symptom remedies, which often contain unneeded medication or contain individual ingredient doses which may be too low to be effective.

- Generally, 10% of UW students get the flu shot every year. This shot is effective against the human flu, but not the H5N1 bird flu.

Epidemiological Model (20 minutes)

[Script] We have probably all seen movies such as Outbreak, where the hero is shown a large screen the size of an entire wall with red circles covering cities and growing like blood. The red is supposed to indicate the predicted areas affected by some type of outbreak. Have you ever wondered how they make those predictions? Since the avian influenza cannot yet be spread between humans, we do not know the values for the different parameters that will affect its spread. Epidemiologists develop computational models for the spread of diseases where they can alter the values of these different factors to determine the risk of the disease becoming an epidemic or pandemic. Today we are going to step through a fictional flu outbreak. What are some of the factors that you think are important for determining how the disease will spread? [Write students' comments on the board, make sure they have these:

- Duration of infection – time during which a person can make others sick
- Rate of transmission– number of people per day that one person can make sick
- Mode of contagiousness - What interaction between a carrier and a susceptible individual will result in disease transfer.
- Virulence – fraction of people that get sick and die
- Incubation period – the time between infection and first symptoms
- Initial immunity in community – the fraction of the community that cannot get sick

For our simulation, we will assume the following

- Duration of infection – 2 days
- Rate of transmission – 1 person/day
- Virulence – non-fatal (0.00)
- Initial immunity in the community – none
- Mode of contagiousness – arms reach

Simulation:

Hand out red (day 1), pink (day 2), and white (immune) labels and data recording worksheet to each student. Data recording sheet and transparency will be provided to instructors before class.

Record data on transparency and tell students to do the same. Also, plot lines representing the number of people in the room that are sick, immune, and susceptible on each day.

Make sure that students are generally in a cluster so that the average person in the room can touch two people without leaving their chair.

Day 1

- one student will be sick (red card)

- record data.
- sick student will infect another student
- end of day.

Day 2

- original sick person is still infectious, but recovering (pink)
- newly sick person holds red card
- record data
- sick students each touch one new person
- end of day

Day 3

- original sick person is fully recovered and now immune (white)
- newly infected become red and reds become pink
- record data
- sick students each touch one new person
- end of day

Day 4…

b) repeat day 3 events until everyone has either been sick or is out of range
c) Ask students to raise hands if they were sick at some point in simulation
d) Plot data on graph

Questions (ask questions and have students contribute answers):

e) What could we have done to stop the spread of the disease?
    1. "Quarantine" part of the room
    2. Increase background immunity of part of the room [later session]
    3. Hand out drugs that stop spread of the disease [later session]

f) What factors could have helped the spread of the disease into a pandemic?
    1. Talk about milling about the room
    2. Introduce idea of mutation allowing the virus to circumvent treatments and immunity to increase rate of transmission (antigenic shift and drift)

[script] For homework, you will use an on-line computer simulator that will allow you to alter the parameters for various factors that affect the spread of the flu. Given a time course, such as the one you have just generated, you will need to describe what conditions could give rise to that time course. In addition, you will describe the time course for different sets of parameters.

Using in-class computer, go to:
science.education.nih.gov/supplements/nih1/diseases/activities/activity4-flash.htm

Show them how the simulator works using the default conditions that were used in the class simulations. Ask students to suggest one variable to change and go through

the simulation. Discuss the differences between simulations. Before class, be sure that you know how variables affect the trends and that you can get the simulator to work in the classroom.

Handouts

Homework: Computer Simulation

You will use an on-line computer simulator that will allow you to alter the parameters for various factors that affect the spread of the flu. In addition, you will describe the time course for different sets of parameters.

For this activity, you will need to go to the National Institutes of Health website at: http://science.education.nih.gov/supplements/nih1/diseases/activities/activity4-flash.htm

Plot the 30-day time course of the number of susceptible, sick, immune, and dead individuals and answer the questions for each scenario:

A. *The in-class simulation*
Initial Immunity: 0%
Virulence: 0%
Duration of Infection: 2 days
Rate of Transmission: 1 person per day

Over 30 days, how many people got sick?

B. *Flu-shots*
Initial Immunity: 10%
Virulence: 0%
Duration of Infection: 2 days
Rate of Transmission: 1 person per day

How does this time course compare to the in-class simulation?

C. *Killer flu*
Initial Immunity: 0%
Virulence: 10%
Duration of Infection: 2 days
Rate of Transmission: 1 person per day

Do you think this is a bad killer flu outbreak?

D. Super flu

State the epidemiological properties of a non-fatal flu virus that will make the most number of people sick in 30 days and plot the number of people that are susceptible, sick, immune, and dead

E. Super-killer flu

State the epidemiological properties of a flu virus that will kill the most people in 30 days and plot the number of people that are susceptible, sick, immune, and dead

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Readings

There are no assigned readings for this unit.