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Modeling HIV Transmission Within a Population

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Abstract:
Modeling HIV Transmission Within a Population

HIV is a virus that is transmitted by fluids form person to person. When it is introduced into a population it can be transmitted at a high or low rate, depending upon the lifestyle choices of the members of that population. We used a solution and indicator to model the rate of transmission in a Living Environment Lab activity. Students were assigned lifestyles that were not indicative of their actual life, but rather roles that they were playing to demonstrate the differences in the transmission of the disease. The students kept track of who they mated with (shared fluids) and in what order they mated. Once the activity was completed they used their recorded data and sheets to build a flow chart in math class. This flow chart allowed them to pinpoint the person who had the original disease. From this information they graphed the transmission with excel and built a model with AgentSheets to study ways of preventing HIV transmission and infection.

Modeling HIV with Agent Sheets and Excel Justification

We chose the software that we used based on their ability to demonstrate the principles of disease transmission in a population. Excel was used as a spreadsheet and for its ability to graph the rate at which HIV was spread throughout a population. Excel is also a program that was easy for our eighth graders to use and manipulate. Students used Agent Sheets to build a simple model of the transmission rate of HIV. We choose to use Agent Sheets because it is the only program that allows you manipulate variables within a population. The students manipulated the virulence of the disease and made predictions as to how many of the agents would actually get the disease when the virulence was altered. The combination of these two modeling software allowed the students to best visualize the effects of different lifestyle choices on their health and the possibility of disease transmission on a population.

The History of AIDS

AIDS is short for Acquired Immune Deficiency Syndrome .It is the most advanced stage of HIV disease. In 1983 scientists discovered the virus that caused AIDS. It was HTLV-LLL/LAV but they shortened the name to the Human Immunodeficiency Virus, or HIV. Over 27 million people have died since the first AIDS case was identified in 1980. Scientists still don't know how it started but some think it was started by subspecies of chimpanzee in Africa. Others think the disease was started in 1959 when scientists got a blood sample from an unknown man, but they don't know how he got it. In 1978 gay men in the United States and Sweden and heterosexuals in Tanzania and Haiti began to show signs of AIDS.

HIV Transmission

HIV is transmitted by having sex with an infected person. But besides having sex, there are many other ways that you can get HIV. You can get HIV by sharing needles, body fluids, blood contact, and from breast milk. HIV is found in blood, semen, vaginal fluids, breast milk, saliva, tears and biting and can be transmitted through the eyes and the nose, if body fluids enter through those areas. Some people can be born with it if the mother is HIV positive. When a mosquito bites a child it can accidentally transmit the disease into the body, making mosquitoes the main source of children getting HIV.

Transmission rates are different among different country. But everyday 20,000 people are infected with HIV.36 million people around the world are HIV. 22 million people have died from the disease. Aids are the fourth leading cause of death globally.60% of men was infected through homosexual sex, 25% through injection drug use and 15% through heterosexual sex. The newly infected men 49% are black, 30% are white, 20% are Hispanic's and 1% are of other racial and ethnic groups.

What are the chances of getting HIV? Anyone who engages in risky behavior is at a higher risk of getting the virus. You can get the virus by having sex with no condom (if the condom slips or breaks are at a higher of getting HIV), having many sex partners, or by sharing needles. To lower these chances use a condom, know if your partner has HIV or not, make sure the needles you use are clean, have your own blood stored before you go into surgery, or carry a pair of latex glove incase you help a hurt person. To prevent transmission of HIV have safe sex or no sex, get tested with your partner to see if the virus is present, and don't share needles. If you're a doctor, nurse, or just someone who likes to help other people, wear latex gloves when handling other people's blood or body fluids.

Population In America Infected

In the United States there is a population over 6,000,000 people that are infected, but since 1981 it has been reported cases that over 9,000,000 are infected. Since 1992 scientist have estimated that roughly half of the people living with HIV will develop AIDS within 10 years. The Niaid thinks an estimation of 30.6 million globally were living with HIV/AIDS as of December 1997. Scientist estimated that HIV will reach 40 million people by 2000. The United States Center for Disease Control and Prevention says the prevalence of AIDS is six times higher in African American and three times higher among Hispanic people than among white. According to the World Health Organization in 2003 19.2 million women was living with HIV/AIDS.

Problems Encountered

Some of the problems encountered during this project were collating the topic we had in mind with what the curriculum time line. The topics and material that was involved in this project did not show up in the curriculum until later in the year so we had to find a way to move the material up and teach what was needed before beginning the project.

We had trouble getting some of the eighth graders to begin the lab right away because they were scared or embarrassed that they may get HIV even though it was clear that the lab was fictional.

Evaluation of Results

Lab results – shows who mated with whom and in what order. This allowed us to make a tree diagram and use probability in math to determine the possibility of disease transmission occurring.

Data Table	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1. Homosexual HS Student	*																													
2. Prostitute		*			4			3			5	6					1	7											2	
3. HS Girl, Doesn't Date			*																											
4. Abstinent				*																										
5. Intravenous Drug User					*																									
6. Steroid Abuser				3	*					4	2										1									
7. HS Girl/ 28 Yr Old Man							*																							
8. HS Student/ Church Volunteer	1						*									2														
9. Student- Sickle Cell								*																						
10. Monogamous									*			1												2						
11. Promiscuous	1		4	3		6			*		2	5																		
12. Female Athlete												*																	1	
13. 16-yr old Runaway		7				5		2	3		*		1								6		4							
14. Hemophiliac													*																	
15. 16-yr old Gang Member					3			4		1	*		5									2								
16. Student-Steady Boy/Girlfriend										1	*				3		2													
17. Good Kid													*																	
18. HS Student-Safe Sex	2									1			*																	
19. "A" Student															*															
20. HS Student-Career First																	*													
21. HS Student-Active in Clubs					2					4			3		5		*	1												
22. Football QB							1			2	3							*												
23. Chess Club President																						*								
24. HS Student-Suspended Often								2			3	1	4							*										
25. Student-goes to parties																							*							
26. Male Athlete																								*						
27. HS Student-Works 30+ Hrs																									*					
28. Brother-Cares for Siblings																										*				

Activity results

Overall I think the project was a success. It showed the students that no one is immune to the AIDS virus no matter how safe you think your being. The students also had a great time with the lab and found it interesting to see how the HIV virus started with one person and was able to spread downwards. In addition, when we used the modeling software to demonstrate the transmission of the disease the students got to see how their activity looked like. This helped them to better understand the process of transmission. In addition, when we had the students determine a virulence for the disease

in the software, from 0 to 100% and make predictions they demonstrated a clear understanding of disease transmission.

Curriculum Standards

Science Standard 1: **Mathematical analysis, scientific inquiry, and engineering design.**

Key Idea: 1 The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process.

Science Standard 4: **Living Environment.**

Key Idea: 7 Human decisions and activities have had a profound impact on the physical and living environment.

Math Standards

Key Idea 1: Mathematical Reasoning: Students use mathematical reasoning to analyze mathematical situations, make conjectures, gather evidence, construct an argument and justify their solutions throughout the curriculum (with a focus on proportional reasoning).

Key Idea 4: Modeling/Multiple Representation: Students use the concept of similarity and scale drawing in various contexts.

Key Idea 6: Uncertainty: (Relates to RCSD's Probability and Estimation) Students use with understanding fundamental ideas of probability.