Students' and Teachers' Mental Models of Viruses

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Background

- Viruses impact the health of billions worldwide
- Developmental and cross-cultural work has investigated people's understanding of illness mostly from a health perspective, i.e., how diseases are spread^{1,2,3}

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- Infection, illness, transmission, and vaccination are all related to the basic biological properties of viruses and the organisms that they infect
- What do people believe about the biological entities and events involved in viral infection?

Objective

- Report preliminary findings about people's understanding of the biological bases of viral infection
- What do students and teachers believe about the events underlying infection?
- How do student and teacher beliefs relate to a scientific models?

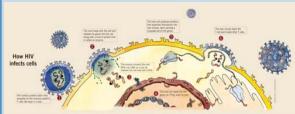


Fig. 1. How HIV infects cells. Image courtesy of the University of Nebraska State Museum for Explore Evolution funded by the National Science Foundation.

Predictions

- Teachers will describe more intracellular processes than students
- Both teachers and students will have misconceptions and gaps in understanding

Participants

- 125 Lincoln public school students, 13-16 yrs (66M:59F)
- 18 Omaha public school teachers

Methods

Students completed an 8-question survey about viruses, including two key questions about infection:

- 1. Describe a virus (what is it and what does it do?).
- 2. How do viruses make you sick? Please explain your answer.

Teachers completed a semi-structured clinical interview about viruses, including probes such as:

- 1. What is a virus?
- 2. How do viruses infect living things?

Coding

Student surveys

• Used statements about (a) what type of cells the virus interacts with, and (b) what the virus does to the cell to classify responses

Teacher interviews

- Infection was described in terms of the interaction between a virus and a host cell
- Used statements about the nature of the interaction between virus and host to classify responses

Findings

Student surveys

Category	n	Examples
Virus uses regular cells to replicate	19 (15%)	"[Viruses] take over cells and multiply inside of them" "[Viruses] get into your cells and replicate" "[Viruses]inject their DNA structure system stuff into your cells"
Virus attacks/ destroys regular cells	29 (21%)	"Viruses get into your body and attack cells" "[Viruses] infect ourblood vessels" "[Viruses] act like parasites and feed off your cells"
Virus attacks/ destroys immune cells	26 (23%)	"[The virus] destroys the antibodies that are there to make you healthy" "Viruses make your immune system weak" "[Viruses] affect your immune system and make it hard to digest"
Nonspecific	51 (41%)	"[The virus] gets into your system and can make you really sick" "By infecting your body they make you sick" "Some viruses are bad"

Besides nonspecific responses, most frequent response category involved viruses entering the body and destroying cells [$\chi^2(3, N = 125) = 18.3$, ρ <.05]. Least frequent was the 'invade host and replicate' category.

Teacher interviews

Category	n	Examples
Virus uses host to replicate its own genetic material	8 (44%)	"[Viruses] have to take part of that cell's genetic structure and incorporate their own in order forreproduction"
Infected cell divides to spread virus	2 (11%)	"[Viruses] worm their way in [to the cell], change the DNA of the cell, so kind of morph it or change it into a virus and then reproduce that wayby binary fission, splitting."
Virus transmits harmful substance to host	2 (11%)	"The end of the tentaclesgo into the cellinjects the venom into the host"
Virus transforms host into virus	1 (6%)	$\hbox{``[Viruses]change the DNA of the cell, so kind of morph it or change it into a virus''}$
Virus consumes/eats host	2 (11%)	"[Viruses] smoosh out the healthy cellsMaybe they surround it or eat, destroy it somehow, weaken it"
Nonspecific	3 (17%)	"Well, I guess it would have to read the DNAwhat I don't know is then does the virus, like a cell does, divide to make a new virus? I'm not certain."
	Virus uses host to replicate its own genetic material Infected cell divides to spread virus Virus transmits harmful substance to host Virus transforms host into virus Virus consumes/eats host	Virus uses host to replicate its own genetic (44%) material Infected cell divides to spread virus Virus transmits harmful substance to host Virus transforms 1 (6%) Virus consumes/eats host Nonspecific 3

Most frequent response category involved viruses invading host cell and using host cell genetic material to replicate $[\chi^2(5, N = 18) = 10.7, p=.05]$.

Discussion

- Students seldom mentioned virus replication and intracellular processes
- Further probing needed to determine the belief structures underlying students' responses about infection
- Most teachers could discuss intracellular processes, but varied in their beliefs
- Some teachers had inaccurate or shallow belief structures
- Current work is analyzing interview data for relations between beliefs about infection and other topics, including the biological basis of virus transmission and vaccination

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