

Activity Guide for Students: Catching the flu

Purpose: To gain a better understanding of influenza, its genomes, mutations and vaccines.

Procedural overview: This guided research activity encourages the exploration of public data and information to learn more about influenza's genes and proteins, how a flu vaccine is made and the nine human genes that predict how well a flu vaccine will work in a person.

Resources:

- *Science News for Students*: "[Explainer: What is a vaccine?](https://www.sciencenewsforstudents.org/article/explainer-what-vaccine)" (https://www.sciencenewsforstudents.org/article/explainer-what-vaccine)
- *Science News for Students*: "[Explainer: What is a virus?](https://www.sciencenewsforstudents.org/article/explainer-what-virus)" (https://www.sciencenewsforstudents.org/article/explainer-what-virus)
- [Uniprot Protein Data Base](http://www.uniprot.org) (http://www.uniprot.org)
- [Protein Data Bank](http://www.rcsb.org/pdb/home/home.do) (http://www.rcsb.org/pdb/home/home.do)
- [National Center for Biotechnology Information](https://www.ncbi.nlm.nih.gov) (https://www.ncbi.nlm.nih.gov)
- [CDC Influenza](https://www.cdc.gov/flu/index.htm) (https://www.cdc.gov/flu/index.htm)
- [ViralZone](http://viralzone.expasy.org) (http://viralzone.expasy.org)
- [Virus Pathogen Resource](https://www.viprbrc.org) (https://www.viprbrc.org)
- [NCBI Influenza Virus Resource](https://www.ncbi.nlm.nih.gov/genomes/FLU/Database/nph-select.cgi?go=database) (https://www.ncbi.nlm.nih.gov/genomes/FLU/Database/nph-select.cgi?go=database)

Procedure:

Do research online or in books to answer the following questions. Write down your answers as you go and be prepared to discuss your findings in class.

1. Is the genome of a flu virus made of DNA or RNA, and is it single-stranded or double stranded?

2. How many separate segments or pieces is the flu virus genome divided into? What genes are on each piece, what are the genes' associated proteins and what do those proteins do?

3. Different strains of influenza can have different versions of each of these genome segments. For the influenza A virus, how many known versions of HA are there?

4. For the influenza A virus, how many known versions of NA are there?

5. Including all of the known HA and NA versions, how many possible influenza A strains are there?

6. In terms of the benefits to the virus, why is it important for influenza to have so many possible HA and NA glycoprotein versions?

7. The annual flu vaccine usually contains HA and NA glycoproteins from three different flu strains. How many different strains could the vaccine protect against?

8. Suppose that one flu virus strain has its own version of each of its genome segments, and a second flu virus strain has a different version of each of the genome segments. If both flu strains infect the same cell, the new virus particles that get assembled may end up with some genome segments from one strain and some from the other strain. Assuming that each new virus ends up with one copy of each genome segment, and that each genome segment can come from either original flu strain, how many possible flu strains could be produced by that one doubly-infected cell?

9. Why does the flu virus mutate so easily?

10. In what parts of the United States is the flu currently the worst? See: [The Weekly US Map: Influenza Summary Update](https://www.cdc.gov/flu/weekly/usmap.htm) by the Centers for Disease Control and Prevention (<https://www.cdc.gov/flu/weekly/usmap.htm>)

11. Listed below are the nine genes whose activity was found to be correlated with strong immune responses to flu vaccines. From online searches, briefly summarize what is known about the function of each gene's corresponding protein, and speculate why the protein (and the amount of the protein produced, called its gene expression level) might be involved in strong immune responses to flu vaccines.

RAB24

GRB2

DPP3

ACTB

MVP

DPP7

ARPC4

PLEKHB2

ARRB1

12. What have you learned about influenza that has surprised you?