STO-162

An Influenza Pandemic?

Teacher Information

science take·out
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Summary

Follow a fictitious scenario about an influenza outbreak.

- Conduct simulated lab tests to determine if the outbreak is caused by a novel virus.
- Determine if this outbreak is seasonal flu or pandemic flu.
- Use models to explain how mixing of genes from birds, pigs, and humans could produce a pandemic virus.
- Explain why current vaccine production technologies will be inadequate if pandemic influenza occurs.

Core Concepts

- An influenza pandemic occurs when a novel influenza virus spreads around the world.
- Pandemics may result from a new virus produced by genetic reassortment (gene mixing) between human viruses and animal viruses.
- The yearly flu vaccine will not be effective in preventing a pandemic caused by a new virus.
- Production of a vaccine for a pandemic virus is a time consuming process.

Time Required

2–3 forty-minute class periods

Kit Contains

- **Seasonal Flu and Pandemic Flu** chart
- Virus Antigen Test Kit:
  - Patient Virus Sample (simulated)
  - Dropper
  - Well strip
- **Host Cell** diagram
- Foam tray to represent host cell nucleus
- Six labeled plastic cups to represent human, pig, bird, and new virus capsids
- Bag of colored fuzzy stems, sparkly stems, and twist-ties to represent viral RNA from humans, pigs, and birds
- Stickers to represent viral antigens from humans, pigs, and birds

Teacher Provides

- Safety goggles
- Paper towels for clean-up

Warning: Choking Hazard

This Science Take-Out kit contains small parts. Do not allow children under the age of seven to have access to any kit components.

Suggestions for Teachers

- This kit was developed before the COVID-19 pandemic. Students should understand that COVID-19 and influenza are very different. Because COVID-19 is caused by a novel virus, making a vaccine to provide immunity is more difficult and takes longer than producing an influenza vaccine.

- This kit works well if students work in teams of three when completing Part 3. Each member of the team could make one of the virus models (red, green, or blue).

- If reading and following instructions is a problem for your students, consider reading and demonstrating the instructions in Part 3.

- For Part 3, a few students may find that none of their models are likely to cause a dangerous pandemic. If this happens, encourage other students in the class to show one of their models and explain why it would be likely to cause a pandemic.

- Collaborate with social studies teachers to explore the impact of past pandemics at https://www.cdc.gov/flu/pandemic-resources/basics/past-pandemics.html

Teacher Resources

- CDC – **How Is Pandemic Flu Different from Seasonal Flu?** https://www.cdc.gov/flu/pandemic-resources/basics/about.html

- CDC – **Influenza (Flu)** https://www.cdc.gov/flu/index.htm

- CDC – **Pandemic Influenza** https://www.cdc.gov/flu/pandemic-resources/index.htm

- CDC – **Key Facts about Seasonal Flu Vaccine** https://www.cdc.gov/flu/protect/keyfacts.htm

- CDC – **How Influenza (Flu) Vaccines Are Made** https://www.cdc.gov/flu/protect/vaccine/how-fluvaccine-made.htm

- WHO – **Pandemic Influenza: Introduction** https://openwho.org/courses/pandemic-influenza-introduction

- **Scientists Say New Strain of Swine Flu Virus is Spreading to Humans In China** https://www.nytimes.com/2020/06/30/world/asia/h1n1-swine-flu-virus-china-pig.html

Reusing the Kit

Teachers will need to instruct students on how to handle cleanup and return of the reusable kit materials. For example, teachers might provide the following information for students:

Discard	Return to kit bag
• Used well strips • Colored stickers on the 6 "Virus" cups* ** NOTE: Do not peel the virus name labels ("Human/Avian/Swine/New Influenza Virus") off the 6 Virus cups. Do peel the red, green, and blue shaped stickers off the 6 Virus cups and save the labeled Virus cups.*	• **Seasonal Flu and Pandemic Flu** chart • **Host Cell** diagram • 6 labeled "Virus" cups (without the colored stickers) • Pink foam tray • Fuzzy stems, sparkly stems and twist-ties • Tube of Patient Virus Sample • Dropper

Refills for the **An Influenza Pandemic?** kits are available at www.sciencetakeout.com. The 10 Kit Refill Pack includes the following materials:

- 15 mL of Patient Virus Sample (simulated)
- 10 well strips for virus antigen tests
- Stickers (60 red heart, 60 blue round, 60 green star)

Next Generation Science Standards (NGSS) Correlation

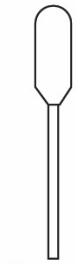
Working Towards Performance Expectations

HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.

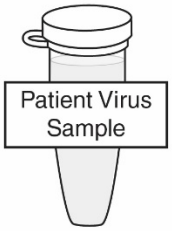
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms

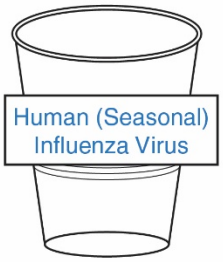
Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. Evaluate the impact of new data on a working explanation and/or model of a proposed process or system Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.	Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1)	The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

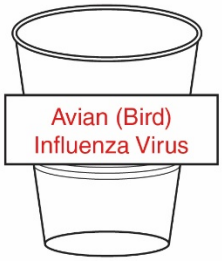
Kit Contents Quick Guide

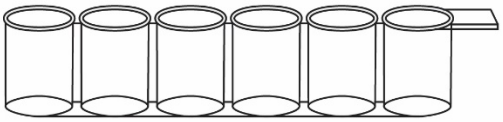


Dropper

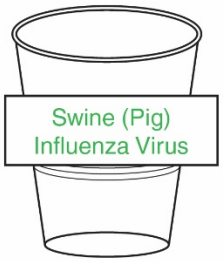


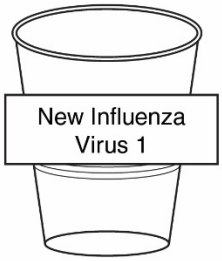




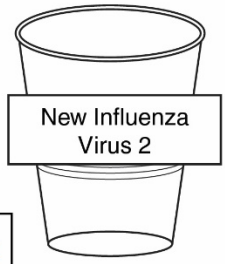


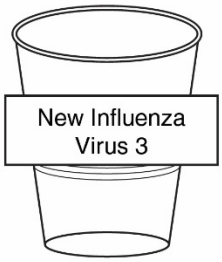
Well Strip

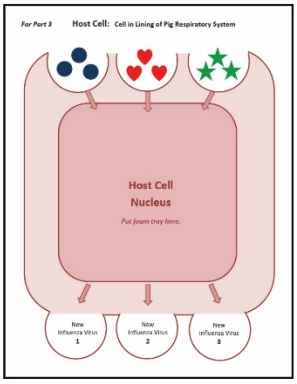


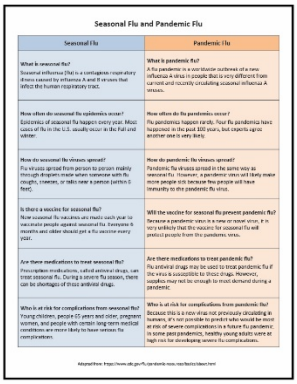


Foam Tray

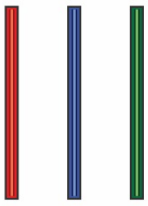






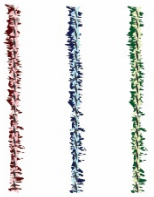


Stickers – 6 of each



Twist Ties – 3 of each

Chenille Stems – 14 of each



Tinsel Stems – 3 of each

Read these instructions before using Science Take-Out kits

Adult Supervision Required

This kit should be used only under the supervision of an adult who is committed to ensuring that the safety precautions below, and in the specific laboratory activity, are followed.

Chemicals Used in Science Take-Out Kits

Every effort has been made to reduce the use of hazardous chemicals in Science Take-Out kits. Most kits contain common household chemicals or chemicals that pose little or no risk. Safety Data Sheets (SDS) provide specific safety information regarding the chemical contents of the kits. SDS information for each kit is provided in the accompanying teacher instructions. We encourage students to adopt safe laboratory practices when using chemicals.

Warning: Choking and Chemical Hazard

Science Take-Out kits contain small parts that could pose a choking hazard and chemicals that could be hazardous if ingested. Do not allow children under the age of seven to have access to any kit components.

No blood or body fluids from humans or animals are used in Science Take-Out kits. Chemical mixtures are substituted as simulations of these substances.

General Safety Precautions

1. Never taste, smell, or ingest any chemicals provided in the kit - they may be hazardous.
2. Chemicals used in Science Take-Out experiments may stain or damage skin, clothing or work surfaces. If spills occur, wash the area immediately and thoroughly.
3. Report any chemical spills or contact with chemicals to your teacher.
4. Work in a clean, uncluttered area. Cover the work area to protect the work surface.
5. Read and follow all instructions carefully.
6. Pay particular attention to following the specific safety precautions provided by your teacher or included in the kit activity instructions.
7. Do not use the contents of this kit for any other purpose beyond those described in the kit instructions.
8. Do not leave experiment parts or kits where they could be used inappropriately by others.
9. Do not eat, drink, or apply make-up or contact lenses while performing experiments.
10. Wash your hands before and after performing experiments.

An Influenza Pandemic? - *Teacher Answer Key*

Part 1: Doctors are concerned

Rumors have started on social media that an influenza (flu) pandemic is beginning. TV news programs report an unusually large number of flu cases in several states. Hospital emergency rooms are crowded with patients of all ages who have severe, life threatening flu symptoms. Most of the patients report that they had this year's influenza (flu) vaccine.

Laboratory tests revealed that the patients are infected with an influenza virus. However, there is something different about this virus. It is spreading rapidly, making people sicker than usual, and causing more deaths than usual. Doctors are worried that the cases they are dealing with might be pandemic influenza instead of the typical, seasonal influenza.

Use the information in the **Seasonal Flu and Pandemic Flu** chart in your kit to answer questions 1 and 2.

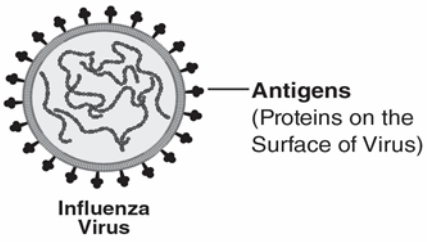
1. Read the information in the text box above. Underline 4 pieces of information in the text box that suggests that this flu outbreak might be the beginning of an influenza pandemic.

2. What questions or additional information might help you decide if this is pandemic influenza?

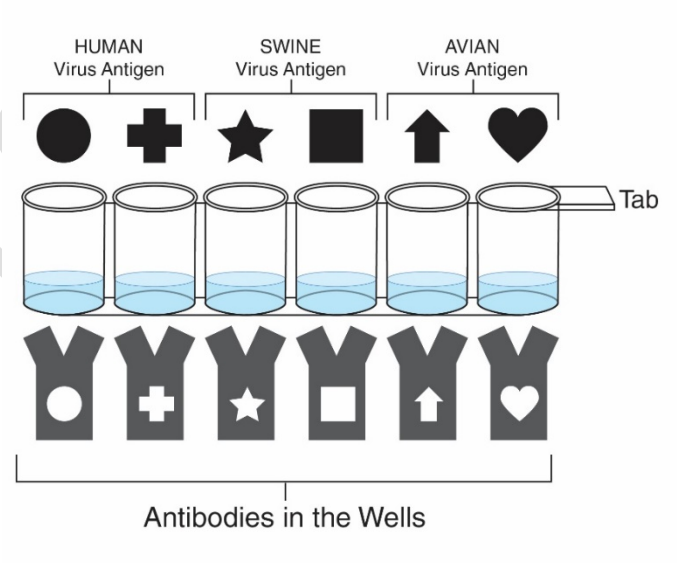
Part 2: Is the pandemic flu virus a human, swine, or avian virus?

It is now official. Scientists from around the world have evidence that a novel (new) influenza virus is causing a pandemic with severe flu symptoms and a high death rate.

Humans can also be infected with viruses from animals such as pigs or birds. Doctors want to know whether the novel virus causing this influenza pandemic is a human flu virus, a swine (pig) flu virus or an avian (bird) flu virus. Laboratory tests can be used to determine whether the **antigens** (surface proteins) on the influenza virus are from a human virus, a swine (pig) virus, or an avian (bird) virus.



You will test a sample of nasal (nose) secretions from a patient with serious flu symptoms. The tests you conduct will show what types of antigens (surface proteins) are present on the influenza virus in the patient sample.



1. Arrange the clear plastic well strip as shown on the diagram. Make sure that the tab on the well strip is on the right.

2. Each well on the well strip is coated with a different type of antibodies. The diagrams above each of the wells show the shape of the antigens that would attach to the antibodies coating that well.

3. Place 2 drops of **Patient Virus Sample** into each well.

4. If an antigen on the virus sample matches with the antibodies in the well, that well will turn pink.

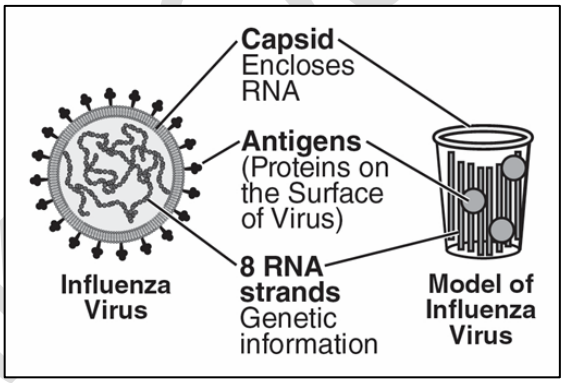
5. Record the results of the antigen test in the diagram above. Draw X's in the wells that turned pink.

6. Based on the antigen test results, is the influenza virus in the patient sample a human virus, a swine virus, an avian virus, or some combination of these? Support your answer with observations from the tests you conducted.

Part 3: Could gene mixing produce a pandemic virus?

How could the pandemic virus have antigens from humans, pigs, and birds? You will use models to show how a pandemic virus could result from **genetic reassortment**—a mixing of genes from human, pig, and bird viruses. First, you will use the materials in the bag labeled **Materials for Influenza Virus Models** to make three virus models—a human influenza virus, an avian (bird) influenza virus, and a swine (pig) influenza virus.

1. Make a model of a **Human (Seasonal) Influenza Virus.**
    - Use the cup labeled **Human (Seasonal) Influenza Virus.** This cup represents the capsid of the human flu virus.
    - Put 6 blue fuzzy stems, 1 blue sparkly stem, and 1 blue twist-tie into the cup. These represent the RNA strands (genetic material) that determine what proteins the human flu virus can make.
    - Attach 3 blue circle stickers to the outside of the cup. The blue circle stickers represent the antigens (proteins) on the surface of the human influenza virus.



2. Make a model of an **Avian (Bird) Influenza Virus.**
    - Use the cup labeled **Avian (Bird) Influenza Virus.** This cup represents the capsid of the avian flu virus.
    - Put 6 red fuzzy stems, 1 red sparkly stem, and 1 red twist-tie into the cup. These represent the RNA strands (genetic material) that determine what proteins the avian flu virus can make.
    - Attach 3 red heart stickers to the outside of the cup. The red heart stickers represent the antigens (proteins) on the surface of the avian flu virus.

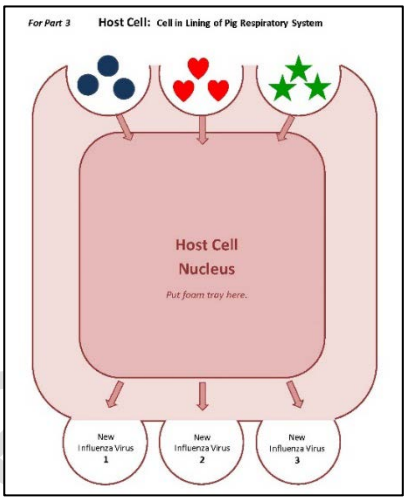
3. Make a model of a **Swine (Pig) Influenza Virus.**
    - Use the cup labeled **Swine (Pig) Influenza Virus.** This cup represents the capsid of the swine flu virus.
    - Put 6 green fuzzy stems, 1 green sparkly stem, and 1 green twist-tie into the cup. These represent the RNA strands (genetic material) that determine what proteins the swine flu virus can make.
    - Attach 3 green star stickers to the outside of the cup. The green star stickers represent the antigens (proteins) on the surface of the swine flu virus.

Genetic reassortment occurs when a new type of virus is produced by mixing virus genes from two or more types of viruses. This may occur when viruses from two or more species of animals infect the same host cell.

Host Cell – A living cell that can be infected by a virus or another type of microorganism.

You will model how a pandemic virus could be produced when human, bird, and pig viruses infect the same pig host cell. Pig cells make good host cells because they have attachment sites for viruses from several different species of animals.

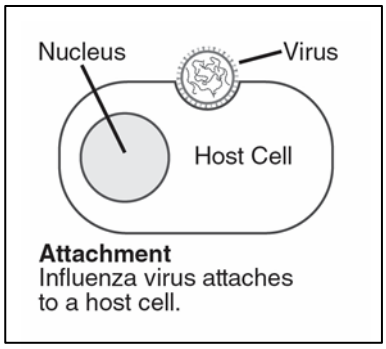
4. Set up the host cell (a cell in the lining of the pig respiratory system). Use the sheet in your kit called **Host Cell: Cell in Lining of Pig Respiratory System**. Put the pink foam tray in the center of the Host Cell sheet. The pink foam tray represents the nucleus of the pig cell.



Put the pink foam tray in the center of this sheet in your kit.

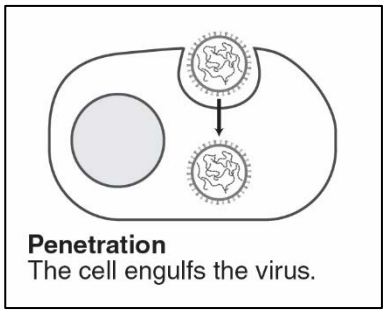
The steps in virus replication are described in steps 5–10 below and illustrated in the diagrams on the right.

5. Attachment: When an influenza virus infects a host cell, it attaches to receptors on the surface of the host cell.
   - Put the human, avian, and swine virus models on the half circles located at the top of the host cell. Match the antigens (stickers) on the virus models with the shapes on the host cell surface.



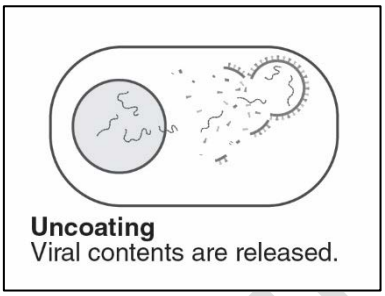
Attachment
Influenza virus attaches to a host cell.

6. Penetration: The attached virus enters the host cell.
   - Move the three virus models (human, pig, and bird) into the host cell.



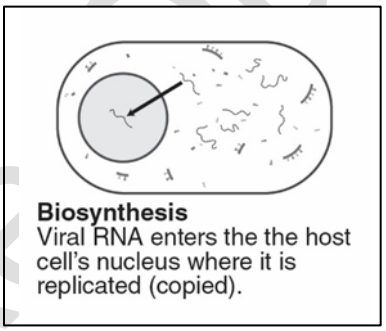
Penetration
The cell engulfs the virus.

7. Uncoating: The RNA (genetic material) from the virus is released and enters the nucleus where it takes control of the host cell.
    - Empty the RNA from the human, bird, and pig models into the host cell nucleus (the pink foam tray).

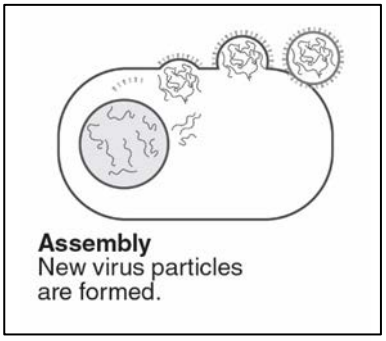

Uncoating
Viral contents are released.

8. Biosynthesis: The virus RNA then directs the host cell to make new viruses:
    - Replicate (copy) the RNA – Add one copy of each of the fuzzy stems, sparkly stems, and twist-ties to the pink foam tray.

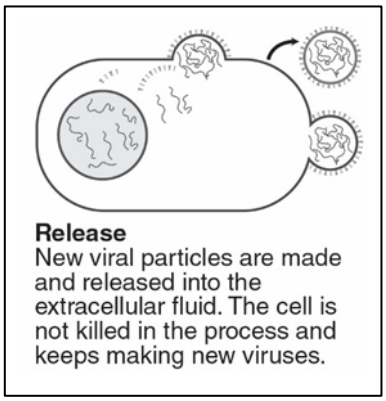
      Hint: Once you have done this, for each color there should be 12 fuzzy stems, 2 sparkly stems, and 2 twist-ties.


Biosynthesis
Viral RNA enters the the host cell's nucleus where it is replicated (copied).

9. Assembly: The viral parts (RNA, capsid, and surface proteins) assemble to make new viruses. Make three new viruses:
    - Place the three **New Influenza Virus** cups on the circles at the bottom of the host cell.
    - For each cup, randomly (without paying attention to the colors) pick up these items from the host cell nucleus (pink tray) and place them into each of the cups.
        - 1 twist-tie
        - 1 sparkly stem
        - 6 fuzzy stems
    - Use the colors of the fuzzy stems to determine which sticker colors should be attached to the outside of each **New Influenza Virus** cup. Attach one colored sticker for each different color of fuzzy stem in the cup. *Note: There are only three colors of stickers so you should not need more than three stickers on each cup.*


Assembly
New virus particles are formed.

10. Release: The newly assembled virus particles are then released from the cell.
    - Place the 3 new viruses in the circles located at the bottom of the pig cell.


Release
New viral particles are made and released into the extracellular fluid. The cell is not killed in the process and keeps making new viruses.

11. Complete the **New Virus Models Chart** below to describe your three new virus models.

- List the colors of the RNA strands (twist-tie, sparkly stem, and fuzzy stems) for each of the new viruses.
- List the colors and shapes of the antigens (surface proteins) for each of the new viruses.

New Virus Models Chart

	RNA strands Determine what kinds of proteins the virus makes			**Antigens** Determine what kinds of host cells the virus can attach to and infect	
	Twist-tie Color	**Sparkly Stem Color**	**Fuzzy Stem Colors**	**Sticker Shapes**	**Sticker Colors**
New Influenza Virus 1					
New Influenza Virus 2					
New Influenza Virus 3					

12. Genetic reassortment occurs when a new type virus is produced by the mixing of virus genes from two or more different types of viruses. Which of the new virus models listed in the **New Virus Models Chart** provide evidence of genetic reassortment? Support your answer with observations of the virus models.

13. Assume that the blue round stickers represent antigens (surface proteins) that will allow a virus to attach to and infect a cell in the human respiratory system. Which of the new virus models would be capable of infecting a human cell?

14. Write an "**I**" in each of the "New Virus" boxes in the first column of the **New Virus Models Chart** to indicate the viruses that would be able to **infect** a human cell.

15. Pandemics are caused by new viruses that are highly **virulent**—they make people very sick and are particularly deadly because humans have no immunity to them.

Key for Sparkly Stems
- Blue = low virulence
- Green = medium virulence
- Red = high virulence

- Observe the sparkly stem in each of the new virus models. Look at the key on the right.

- Which virus is likely to be the most virulent for humans? Support your answer with observations of the sparkly stems in the virus models.

16. Write a "**V**" in the "RNA Sparkly Stem" boxes on the **New Virus Models Chart** to indicate which viruses are likely to be the most **virulent** for humans.

17. Pandemics are caused by new viruses that are highly **transmissible**—they spread easily from human to human.

Key for Twist-ties
- Red = low transmissibility
- Green = medium transmissibility
- Blue = high transmissibility

- Observe the twist-tie in each of the new virus models. Look at the key on the right.

- Which virus is likely to be the most easily spread from human-to human? Support your answer with observations of the twist-tie on the virus models.

18. Write a "**T**" in the "RNA Twist-tie" boxes on the **New Virus Models Chart** to indicate which are likely to be the most **transmissible**—spread easily from human to human.

19. Which of the three new virus models listed on the **New Virus Models Chart** is most likely to infect humans and cause a dangerous pandemic? Circle the virus model that you selected on the chart, and then support your answer with information from the chart.

20. Explain how genetic reassortment (gene mixing) could result a virus that causes an influenza pandemic.

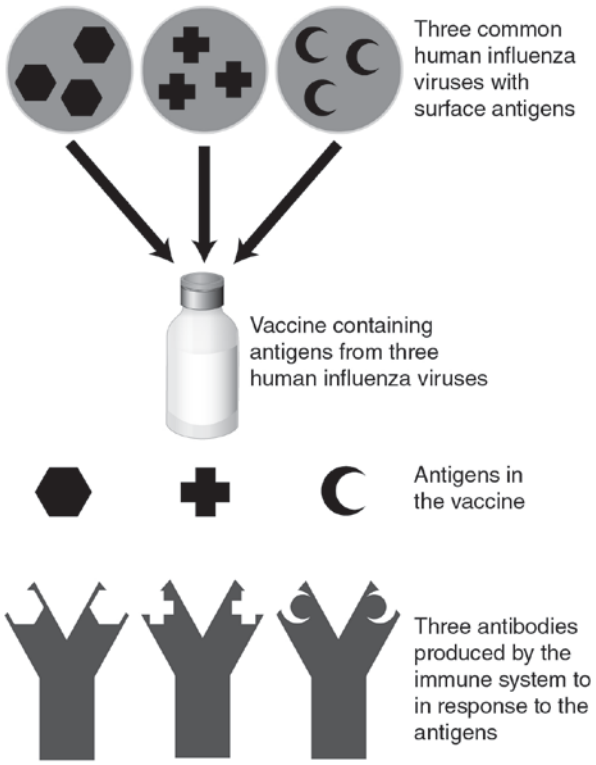
Part 4: Is the seasonal flu vaccine not effective?

People who received a seasonal flu vaccine found that it is not effective in preventing the pandemic flu. Why is the seasonal flu vaccine not providing protection from the pandemic flu?

Each year, there are many different strains of influenza viruses. Each strain of influenza virus has a different antigen shape on its surface. No single influenza vaccine will result in antibodies that can protect against viruses with all possible antigen shapes.

Influenza vaccines typically contain antigens from only three strains of human influenza viruses that scientists predict will be the most common strains of influenza virus during the next flu season.

The influenza vaccine works because the antigens in the vaccine trigger the immune system to produce antibodies that help the body to fight off the infection. It takes about two weeks for the human body to produce the antibodies that help destroy the three strains of influenza viruses that were used to make the vaccine.



Base your answers to questions 1 through 4 on the information in the text box above and the **New Virus Models Chart** on page 6.

1. Why is this year's seasonal flu vaccine not effective in preventing the spread of the pandemic influenza virus?

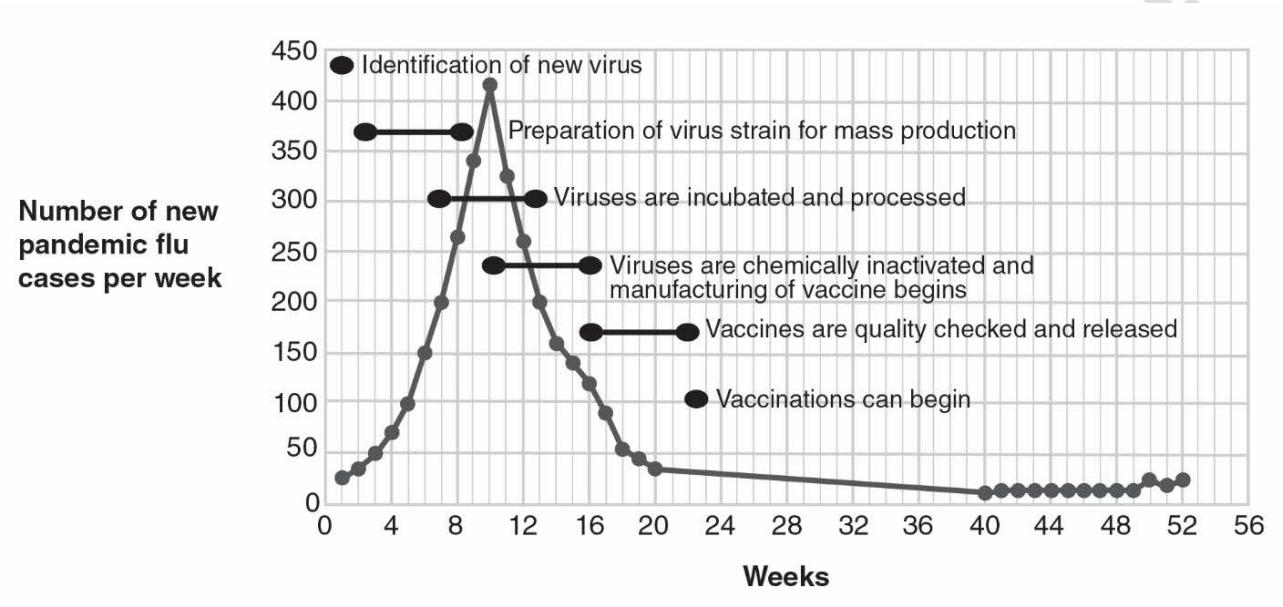
2. What antigen shape (or shapes) should be in a flu vaccine in order for it to be effective against the pandemic virus model that you selected on the **New Virus Model Chart?**

3. Draw an antibody produced in the human immune system that would help destroy the pandemic flu virus in your model. *Hint: Look at your New Virus Models Chart.*

4. Even though the seasonal flu vaccine is not effective against the pandemic flu, doctors recommend that patients should still receive the seasonal flu vaccine. Why do you think this is so?

Part 5: Producing a vaccine for pandemic flu

The graph below shows the number of new pandemic flu cases per week in a city since the beginning of an outbreak of pandemic influenza. The graph also shows the timeline for developing and manufacturing a new vaccine to prevent cases of this pandemic flu.



Graph modified from:
https://pubmed.ncbi.nlm.nih.gov/20093297/ and https://www.who.int/csr/disease/swineflu/notes/h1n1_vaccine_20090806/en/

Base your answers to questions 1–5 on the information from the graph above.

1. Provide an explanation for the changes observed in the number of new pandemic flu cases between weeks 0 and 10.

2. Provide an explanation for the changes observed in the number of new pandemic flu cases between weeks 10 and 20.

3. Approximately how many weeks did it take to identify the new virus that caused the pandemic?

4. Approximately how many weeks did it take to produce a new vaccine that would prevent the spread of the new virus?

5. In total, approximately how many people had been infected with pandemic flu by the time the vaccinations for the new virus strain could begin?

    A. 50

    B. 100

    C. 1,000

    D. 3,000

6. Some people in the city did not take precautions to prevent the spread of the pandemic virus because they believed a vaccine would be developed to protect them. Explain why only relying on vaccine production is not good for public health during a pandemic?

7. By the time the vaccine is available, the number of new pandemic flu cases per week in the city was low. Explain why people should be encouraged to get the new pandemic flu vaccine.

8. If a pandemic flu occurs, millions of people around the world might die before a vaccine could be produced and distributed. Create an informational poster that could be posted in a school or a doctor's office to help educate children and families about the actions they could take to prevent the spread of pandemic flu. Use the information on this website to make your poster: https://www.cdc.gov/flu/pandemic-resources/basics/about.html.

Section 1 Chemical Product and Company Information

Science Take-Out
80 Office Park Way
Pittsford, NY 14534
(585)764-5400

CHEMTREC 24 Hour Emergency
Phone Number (800) 424-9300
For laboratory use only. Not for drug, food or household use

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Product	Buffer Solution pH10
Synonyms	"Patient Virus Sample"

Section 2 Hazards Identification

This substance or mixture has not been classified at this time according to the Globally Harmonized System (GHS) of Classification and Labeling of Chemicals.

Signal word: WARNING
Pictograms: None required
Target organs: None known

GHS Classification:
Skin irritation (Category 3)
Eye irritation (Category 2B)

GHS Label information: **Hazard statement(s):**
H316: Causes mild skin irritation.
H320: Causes eye irritation.

Precautionary statement(s):

P264: Wash hands thoroughly after handling.

P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P332+P313: If skin irritation occurs: Get medical attention.

P337+P313: If eye irritation persists: Get medical attention.

Ca Prop 65 - This product does not contain any chemicals known to the State of California to cause cancer, birth defects, or any other reproductive harm.

Section 3 Composition / Information on Ingredients

Chemical Name	CAS #	%	EINECS
Water	7732-18-5	99.77%	231-791-2
Potassium chloride	7447-40-7	0.10%	231-211-8
Boric acid	10043-35-3	0.08%	233-139-2
Sodium hydroxide	1310-73-2	0.05%	215-185-5

Section 4 First Aid Measures

INGESTION: Call physician or Poison Control Center immediately. Induce vomiting only if advised by appropriate medical personnel. Never give anything by mouth to an unconscious person.

INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

EYE CONTACT: Check for and remove contact lenses. Flush thoroughly with water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get immediate medical attention.

SKIN ABSORPTION: Remove contaminated clothing. Flush thoroughly with mild soap and water. If irritation occurs, get medical attention.

Section 5 Fire Fighting Measures

Suitable Extinguishing Media: Use any media suitable for extinguishing supporting fire.

Protective Actions for Fire-fighters: In fire conditions, wear a NIOSH/MSHA-approved self-contained breathing apparatus and full protective gear. Use water spray to keep fire-exposed containers cool.

Specific Hazards: During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

Section 6 Accidental Release Measures

Personal Precautions: Evacuate personnel to safe area. Use proper personal protective equipment as indicated in Section 8. Provide adequate ventilation.

Environmental Precautions: Avoid runoff into storm sewers and ditches which lead to waterways.

Containment and Cleanup: Absorb with inert dry material, sweep or vacuum up and place in a suitable container for proper disposal. Wash spill area with soap and water.

Section 7 Handling and Storage

Precautions for Safe Handling: Read label on container before using. Do not wear contact lenses when working with chemicals. Keep out of reach of children. Avoid contact with eyes, skin and clothing. Do not inhale vapors, spray or mist. Use with adequate ventilation. Avoid ingestion. Wash thoroughly after handling. Remove and wash clothing before reuse.

Conditions for Safe Storage: Store in a cool, well-ventilated area away from incompatible substances.

Section 8 Exposure controls / Personal Protection

Exposure Limits:

Chemical Name	ACGIH (TLV)	OSHA (PEL)	NIOSH (REL)
Potassium chloride	None established	None established	None established

Engineering controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower and fire extinguishing material. Personnel should wear safety glasses, goggles, or faceshield, lab coat or apron, appropriate protective gloves. Use adequate ventilation to keep airborne concentrations low.

Respiratory protection: None should be needed in normal laboratory handling at room temperatures. If misty conditions prevail, work in fume hood or wear a NIOSH/MSHA approved respirator.

Section 9 Physical and Chemical Properties

Appearance: Clear, colorless liquid.
Odor: No odor.
Odor threshold: Data not available.
pH: 10.0
Melting/Freezing point: Approx. 0°C (32°F) (water)
Boiling point: Approx. 100°C (212°F) (water)
Flash point: Data not available

Evaporation rate (Water = 1): <1
Flammability (solid/gas): Data not available.
Explosion limits: Lower/Upper: Data not available
Vapor pressure (mm Hg): 14 (water)
Vapor density (Air = 1): 0.7 (water)
Relative density (Specific gravity): Approx. 1.0 (water)
Solubility(ies): Complete in water.

Partition coefficient: Data not available
Auto-ignition temp.: Data not available
Decomposition temp.: Data not available
Viscosity: Data not available.
Molecular formula: Mixture
Molecular weight: Mixture

Section 10 Stability and Reactivity

Chemical stability: Stable
Hazardous polymerization: Will not occur.

Conditions to avoid: Excessive temperatures which cause evaporation.
Incompatibilities with other materials: Acids, alkalies, and air will change the buffer's ability.
Hazardous decomposition products: Boron oxide and chlorine gas.

Section 11 Toxicological Information

Acute toxicity: Data not available
Skin corrosion/irritation: Data not available
Serious eye damage/irritation: Data not available
Respiratory or skin sensitization: Data not available
Germ cell mutagenicity: Data not available
Carcinogenity: Data not available

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity: Data not available
STOT-single exposure: Data not available
Aspiration hazard: Data not available
STOT-repeated exposure: Data not available

Potential health effects:
Inhalation: May be harmful if inhaled.
Ingestion: May be harmful if swallowed.
Skin: May cause mild irritation.
Eyes: May cause mild irritation.

Signs and symptoms of exposure: To the best of our knowledge the chemical, physical and toxicological properties have not been thoroughly investigated. Specific data is not available. Exercise appropriate procedures to minimize potential hazards.
Additional information: RTECS #: Data not available

Section 12 Ecological Information

Toxicity to fish: No data available
Toxicity to daphnia and other aquatic invertebrates: No data available
Toxicity to algae: No data available
Persistence and degradability: No data available
Bioaccumulative potential: No data available
Mobility in soil: No data available
PBT and vPvB assessment: No data available
Other adverse effects: An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Section 13 Disposal Considerations

These disposal guidelines are intended for the disposal of catalog-size quantities only. Federal regulations may apply to empty container. State and/or local regulations may be different. Dispose of in accordance with all local, state and federal regulations or contract with a licensed chemical disposal agency.

Section 14 Transport Information

UN/NA number: Not applicable
Shipping name: Not Regulated
Hazard class: Not applicable
Packing group: Not applicable
Reportable Quantity: No
Marine pollutant: No
Exceptions: Not applicable
2012 ERG Guide # Not applicable

Section 15 Regulatory Information

A chemical is considered to be listed if the CAS number for the anhydrous form is on the Inventory list.

Component	TSCA	CERLCA (RQ)	RCRA code	DSL	NDSL	WHMIS Classification
Potassium Chloride	Listed	Not Listed	Not Listed	Listed	Not Listed	Uncontrolled Product
Sodium hydroxide	Listed	1,000 lbs (454 kg)	D002	Listed	Not Listed	E

Section 16 Additional Information

The information contained herein is furnished without warranty of any kind. Employers should use this information only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use of these materials and the safety and health of employees.
NTP: National Toxicology Program, IARC: International Agency for Research on Cancer, OSHA: Occupational Safety and Health Administration, STOT: Specific Target Organ Toxicity, SE: Single Exposure, RE: Repeated Exposure, ERG: Emergency Response Guidebook.

Revision Date: September 9, 2020 Supercedes: