

# THE SCIENCE BEHIND THE FLU SHOT

51

Science Literacy Warm Up

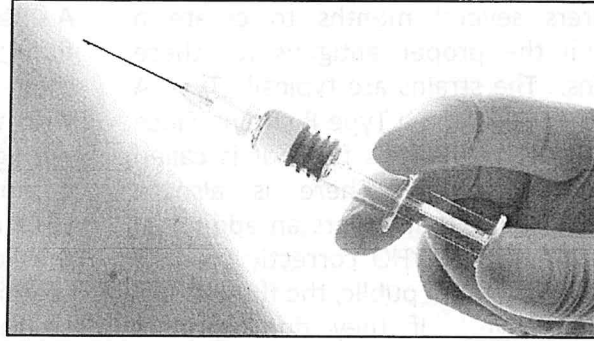
(1) Every year the medical community urges the public to get the flu shot to prevent people from getting sick with the flu during the flu season. In North America, the flu season typically goes from October to May and peaks in February. Many people choose to get the flu shot but have no idea what it is, how it was created or what it actually does.

(2) The flu is a disease caused by the influenza virus or flu virus for short. A virus is a small but non-living infectious particle. There are many strains of the flu virus. A strain is a variation of the flu virus. These strains all tend to do similar things like give you a runny or stuffed up nose, sore throat, fever, body aches, chills and fatigue.

(3) Some influenza strains are more virulent than others. Virulence determines the ability of the virus to cause disease. A virus with greater virulence is more dangerous. You may catch two different strains of flu virus, but one may be able to make you sicker than the other. The Spanish Flu of 1918 was caused by an extremely virulent strain of the H1N1 influenza virus. Unlike most flu strains that target young, old and sick individuals, the 1918 strain targeted healthy individuals and killed them instead of just giving them the typical flu symptoms. The Spanish flu virus killed 3-5% percent of the world's population (50 million – 100 million people), making it one of the largest infectious disease disasters to date.

(4) Some strains of the flu virus prefer certain hosts over others. A host is the organism that the influenza virus infects. For example, there are different strains of swine flu virus. Most of these strains prefer pigs as hosts. If a cat gets infected by the swine flu virus, it most likely won't get sick because it is not the preferred host. In some cases, the influenza virus can change by mutating and this makes it capable of infecting more than its typical host species. In 2009, there was an outbreak of the swine flu within human populations. When it mutated, swine flu H1N1 developed the ability to jump from its usual pig hosts to human hosts.

(5) Since the influenza virus can mutate, this also allows it to confuse and trick the immune system. Normally, when your body is exposed



to new viruses or bacteria, your immune system will memorize the outside coatings of these microorganisms. Each coating contains a very unique set of proteins called antigens that allow the immune system to recognize the same virus in the future. For example, when children get the chicken pox for the first time, they usually never get it again because their immune systems will be able to memorize the chicken pox virus antigens. If exposed to this virus again in the future, the immune system recognizes the virus immediately and can destroy it before it has a chance to multiply. However, when a virus is capable of mutating, it can change its antigens making it hard for the immune system to recognise it. The chicken pox virus mutates very slowly so the immune system can recognize this virus year after year. The influenza virus, however, mutates quickly and this causes frequent antigens changes, making it difficult for the immune system to detect the virus. This is why a new flu shot needs to be made yearly to deal with the new antigens.

(6) A flu shot is a vaccine that contains antigens from flu virus strains. A vaccine works by "introducing" the immune system to the possible antigens that belong to viruses it has not encountered yet, but may encounter in the future. When the antigens in the vaccine are detected, the immune system will create memory cells which will be able to detect these antigens on real viruses in the future.

(7) The typical flu shot contains vaccines for three strains of influenza virus. Every February, the World Health Organization (WHO) announces the three most likely strains of influenza virus that will hit the public in the upcoming flu season. This will give flu vaccine

# THE SCIENCE BEHIND THE FLU SHOT

manufacturers several months to create a vaccine with the proper antigens for these three strains. The strains are typically Type A H1N1, Type A H3N2 and a Type B strain. Since there are three strains, this flu shot is called the trivalent vaccine. There is also a quadrivalent vaccine that covers an additional Type B strain. If the WHO correctly predicts which strains will hit the public, the flu shot will be more effective. If they don't predict correctly, then the flu shot is less effective.

(8) The flu vaccine is made by injecting the flu virus into fertilized chicken eggs. Eggs that are 11 to 12 days old are chosen and disinfected.

A small hole is poked into the egg shell and the flu virus strains are injected inside. The hole is then sealed with wax. The virus incubates within the egg at 37°C/99°F for 48 hours during which time the virus will multiply. After 48 hours, the egg is cracked open and the flu virus is obtained in the fluid. The flu virus is then deactivated and the antigens in the viral coating are isolated and purified. The antigens are then used to make the vaccine which is put into an injectable needle or nasal spray. There are also methods to grow viruses in cell cultures that don't involve chicken eggs. This is to prevent some allergic reactions that can occur in people who may be allergic to eggs.

## Article Questions

- 1) A \_\_\_\_\_ is a non-living infectious particle. The different varieties of flu viruses are called \_\_\_\_\_. The Spanish flu outbreak occurred in \_\_\_\_\_. The \_\_\_\_\_ determines which strains of influenza virus will most likely be those that are the most active during the flu season. An \_\_\_\_\_ is a part of the viral coating that the immune system recognizes. \_\_\_\_\_ flu shots contain antigens from three strains of flu virus.
- 2) When are you the most likely to get the flu if you live in North America?
- 3) If a certain strain of bacteria was called "highly virulent", what does this mean?
- 4) How was the Spanish flu different from the regular flu?
- 5) What is a host?
- 6) How does your immune system remember a virus that you've been exposed to?
- 7) Why does a new flu shot need to be made each year?
- 8) What host is used to make the flu vaccine and why can this host be a problem for some people?

Name: \_\_\_\_\_

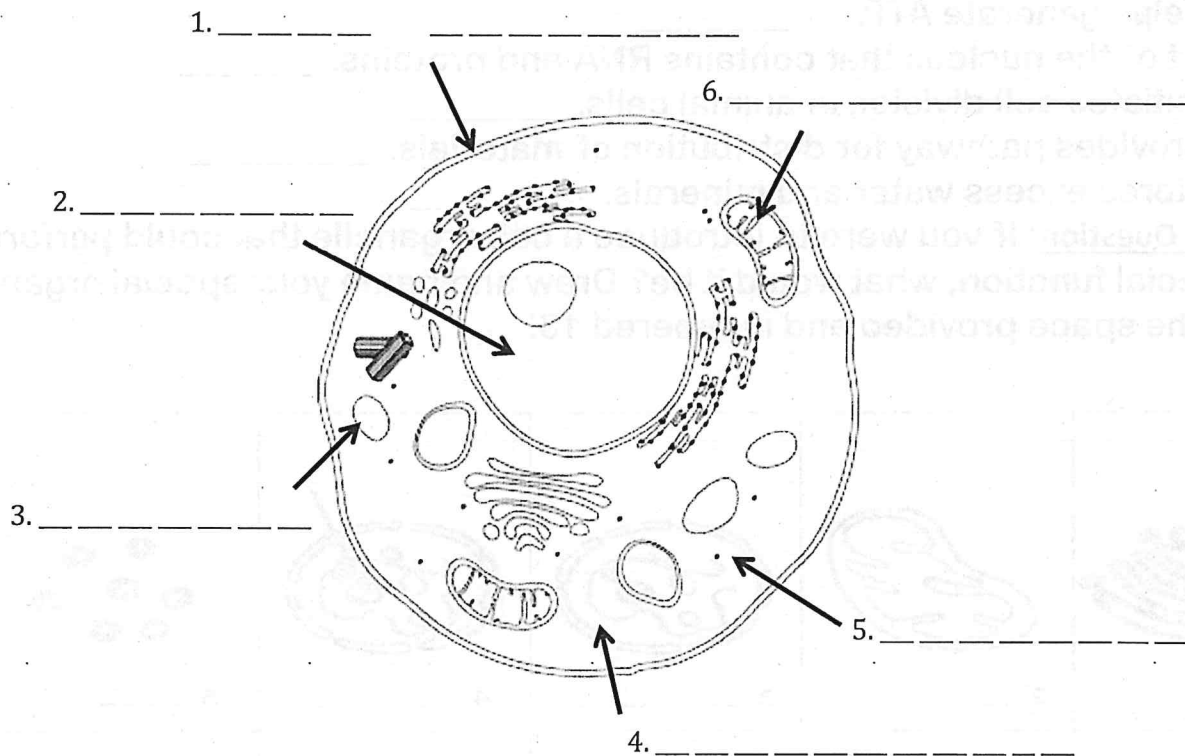
Date: \_\_\_\_\_

## CELLS: The building blocks of life

Cells are the building blocks of life. There are 2 main types of cells – animal and plant cells. Each cell contains internal structures responsible for different functions.

These internal structures are called o\_\_\_\_\_.

Task 1: Label the organelles of the animal cell below.







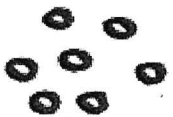
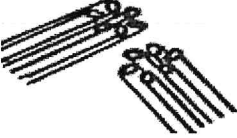

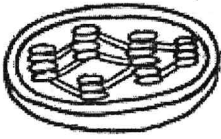

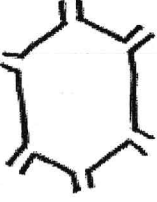
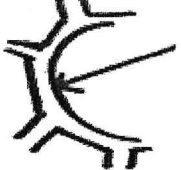

Task 2: Complete the table below on the functions of organelles.

Organelle	Function
Nucleus	
Mitochondria	
Cytoplasm	
Vacuole	
Ribosome	

## The Cell Structure and Functions - Activity

Name the cell structures below the diagrams and color them. Fill in the blanks by mapping the numbers given to the cell structures:

1. It is a non-living membrane found in plant cells only. \_\_\_\_\_
2. It is site for protein synthesis. \_\_\_\_\_
3. It consists of tubules and vesicles and secretes hormones. \_\_\_\_\_
4. It is a plastid that helps in photosynthesis. \_\_\_\_\_
5. It helps generate ATP. \_\_\_\_\_
6. Part of the nucleus that contains RNA and proteins. \_\_\_\_\_
7. It initiates cell division in animal cells. \_\_\_\_\_
8. It provides pathway for distribution of materials. \_\_\_\_\_
9. It stores excess water and minerals. \_\_\_\_\_
10. **Fun Question:** If you were to introduce a cell organelle that could perform a special function, what would it be? Draw and name your special organelle in the space provided and numbered 13.

 1 _____	 2 _____	 3 _____	 4 _____	 5 _____
 6 _____	 7 _____	 8 _____	 9 _____	 10 _____
 11 _____	 12 _____	<div style="border: 1px solid black; height: 150px; width: 100%;"></div> <div style="text-align: right; margin-top: 10px;">13</div>		

Name:

Date:

### Cell Structures and Their Functions

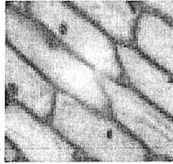
CELL STRUCTURE/ PART/ORGANELLE	FUNCTION/PURPOSE/JOB
nucleus	control center, holds information, holds "genetic material" (DNA), directs activities
cell membrane	controls what goes in and out of cell
mitochondria	release energy from food molecule (glucose/sugar), powerhouse or power plant
cytoplasm	gel-like, watery liquid that is between nucleus and cell membrane, surrounds cell structures, chemical reactions happen in it, substances move through it
vacuoles	bags or sacs that store substances, in plant cells there is one large one that stores water and nutrients and keeps the cell in a normal shape; in animal cells there are many small vacuoles
cell wall	thick, stiff, hard, rigid structure on outside of plant cells, supports and protects the cell
chloroplasts	small green bodies that perform photosynthesis, only in cells of plants and algae

**Use the table to answer the following questions:**

1. You look at a cell under a microscope and see that it is rectangular and has a border around it that is thick. Is it a plant cell or an animal cell?
2. You eat lunch, and then go out to play some hoops. What part of your cell is getting energy out of food molecules so that the cells of your muscles can work?
3. A cell needs oxygen and nutrients to stay alive. What part of the cell lets these substances into the cell?
4. You look at a cell under a microscope. You notice a bunch of small green bodies in the cytoplasm. What are they? What kind of cell are you looking at, plant or animal? (answer both questions, please!)
5. Oxygen moves from one part of the cell to another through the gel-like, watery liquid known as the:
6. You have genetic information in every one of your body cells. This information says what your eye and hair color is and makes you "you." This genetic material is in the cell structure/organelle known as the:
7. A forgetful science teacher doesn't water her plants. There is a large, bag-like structure inside each cell that holds water. It shrinks because it doesn't have enough water! The plants wilt! The structure is known as the:



1. Which ONE of the following correctly matches the organelle with its function?
  - A. cell wall: produces energy for the cell
  - B. nucleus: control center of the cell
  - C. cell membrane: gives rigid structure to the plant cell
  - D. chloroplasts: colorless, jelly-like substance that supports the other organelles
2. Which organelle functions as the "powerhouse" of the cell by producing the energy necessary for all cell functions to occur?
  - A. cytoplasm
  - B. ribosomes
  - C. nucleus
  - D. mitochondria
3. Select the statement that best describes the function of the cell wall.
  - A. It gives shape to plant cells.
  - B. It produces food from sunlight.
  - C. Its jelly-like fluid surrounds the nucleus and most of the cell's internal parts.
  - D. It contains the cell's nuclear material.
4. What is a function of the nucleus of an animal cell?
  - A. It is the place where energy is produced.
  - B. It stores the genetic information, the DNA (chromosomes).
  - C. It defends the cell from infections.
  - D. It captures sunlight to produce food.
5. Select a statement that best completes the phrase below. In a plant cell...
  - A. there is one large vacuole that stores water and helps hold up the plant.
  - B. the vacuoles enter and leave through the cell membrane.
  - C. there are lots of small vacuoles.
  - D. there are no vacuoles.
6. Which of the following does a plant cell have?
  - I. cell membrane
  - II. cell wall
  - III. cytoplasm
  - A. II only
  - B. III only
  - C. II and III only
  - D. I, II, and III
7. Which cell structures are similar in the way they protect, support, and hold the other organelles together?
  - A. Cell Wall, cytoplasm, and lysosomes
  - B. Cell membrane, cytoplasm, and ribosomes

- C. Cell wall, cell membrane, and cytoplasm
  - D. Cell membrane, chloroplasts, and nucleus
8. The fluid substance that holds the organelles of the cell is called the ...
- A. cytoplasm
  - B. cell wall
  - C. nucleus
  - D. ribosome
9. What is the organelle that is a small grain like structure where proteins are made?
- A. cytoplasm
  - B. nucleus
  - C. ribosomes
  - D. Lysosomes
10. Which two plant cell structures are responsible for storing energy from sunlight and later releasing it for cells to use?
- A. chloroplast and nucleus
  - B. mitochondria and cell wall
  - C. chloroplast and mitochondria
  - D. nucleus and cell wall
11. Which two plant cell structures work together, like security guards, for the cell?
- A. Cytoplasm and Nucleus
  - B. Cell Membrane and Cell Wall
  - C. Nucleus and Oxygen
  - D. Oxygen and Cell Membrane
12. This micrograph (picture taken through a microscope) probably shows what type of cell?
- A. animal
  - B. plant
  - C. virus
  - D. bacteria
- 
13. What features do plant cells have that animal cells lack?
- A. Nucleus and cell membrane
  - B. cell wall and chloroplasts
  - C. cytoplasm and cell wall
  - D. cell membrane and chloroplasts

14. What two organelles function as storage units; one for chemicals and the other for such things as food, water, and waste?
- A. cytoplasm and vacuoles
  - B. vacuoles and cytoplasm
  - C. ribosomes and lysosomes
  - D. lysosomes and vacuoles
15. Which cell structures are similar in the way they protect, support, and hold the other organelles together?
- A. Cell Wall, cytoplasm, and lysosomes
  - B. Cell membrane, cytoplasm, and ribosomes
  - C. Cell wall, cell membrane, and cytoplasm
  - D. Cell membrane, chloroplasts, and nucleus
16. Explain how animal cells and plant cells differ.
17. Select two organelles and explain how they work together in the cell.



