



**United States  
Department of  
Agriculture**

Cooperative  
State Research,  
Education,  
and Extension  
Service



## Understanding Avian Influenza

S ometime in the past year or two, you probably have heard about “bird flu.” It has been in the news because the highly pathogenic (high path), or deadly, H5N1 avian influenza virus has infected domestic poultry and wild birds in Asia, Europe, and Africa. This virus has killed both birds and people in Asia and Africa.

You might be wondering “why should I know about this virus and how does it affect me?” While this particular bird flu strain has not arrived in the United States, it already might have affected your life. The aim of this lesson, Understanding Avian Influenza, is to explain the many reasons why you should know about this virus and what it means if it does show up in this country.

Domestic or commercial poultry are birds, such as chickens, turkeys, and ducks, which we often eat as meat or the eggs they produce. Wild birds migrate (or travel) through North America via flyways (or pathways in the sky that birds instinctively follow) to Alaska each year to breed. At the same time, wild birds migrate from Asia every year via flyways to Alaska. These migratory birds from North America and Asia breed in areas that are near each other, which increases the possibility that the birds from Asia could carry the virus to the North American birds.

While high path H5N1 has not been found anywhere in the United States, the rest of North America, Central, or South America, it is possible that it could. Government officials around the world are watching this virus closely and working to slow its spread.

To help you understand better the potential threat of this virus in the United States, this lesson has been divided into three stages. The first stage covers the spread of the highly pathogenic H5N1 avian influenza virus between 1996 (when it first appeared) and 2004. The second and third stages focus on the continued spread and evolution of the high path H5N1 avian influenza virus during 2005 and 2006.



## What Is Avian Influenza?

**Avian influenza** (AI)—also known as bird flu—is caused by a virus that infects wild birds, such as ducks, gulls, and shorebirds that migrate, or fly to different parts of the world depending on the seasons. When it becomes too cold to survive in one climate, they follow the same route every year to warmer weather.

AI can also infect **domestic poultry**, such as chickens, turkeys, ducks, and geese. Domestic or commercial poultry are birds raised to be consumed as food. We eat a lot of poultry and eggs as a main part of our diet in America.

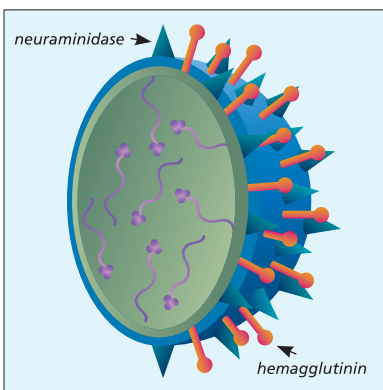
There is flu for birds just as there is for humans and, as with people, some forms of the flu are worse than others. Birds can be infected with two types of flu **pathogenicity**. Pathogenicity is the ability to produce disease, and how serious that disease might become. One form is mild, sometimes even unnoticeable. The other is often deadly to birds.

The mild type is **low pathogenic avian influenza**, or “low path,” avian influenza. Low path avian influenza naturally occurs in some wild birds and can spread to poultry. In most cases, birds show no signs of illness or only minor signs. Scientists and biologists have found low path avian influenza in domestic poultry numerous times in the United States over the years. Low path does not generally make people sick.

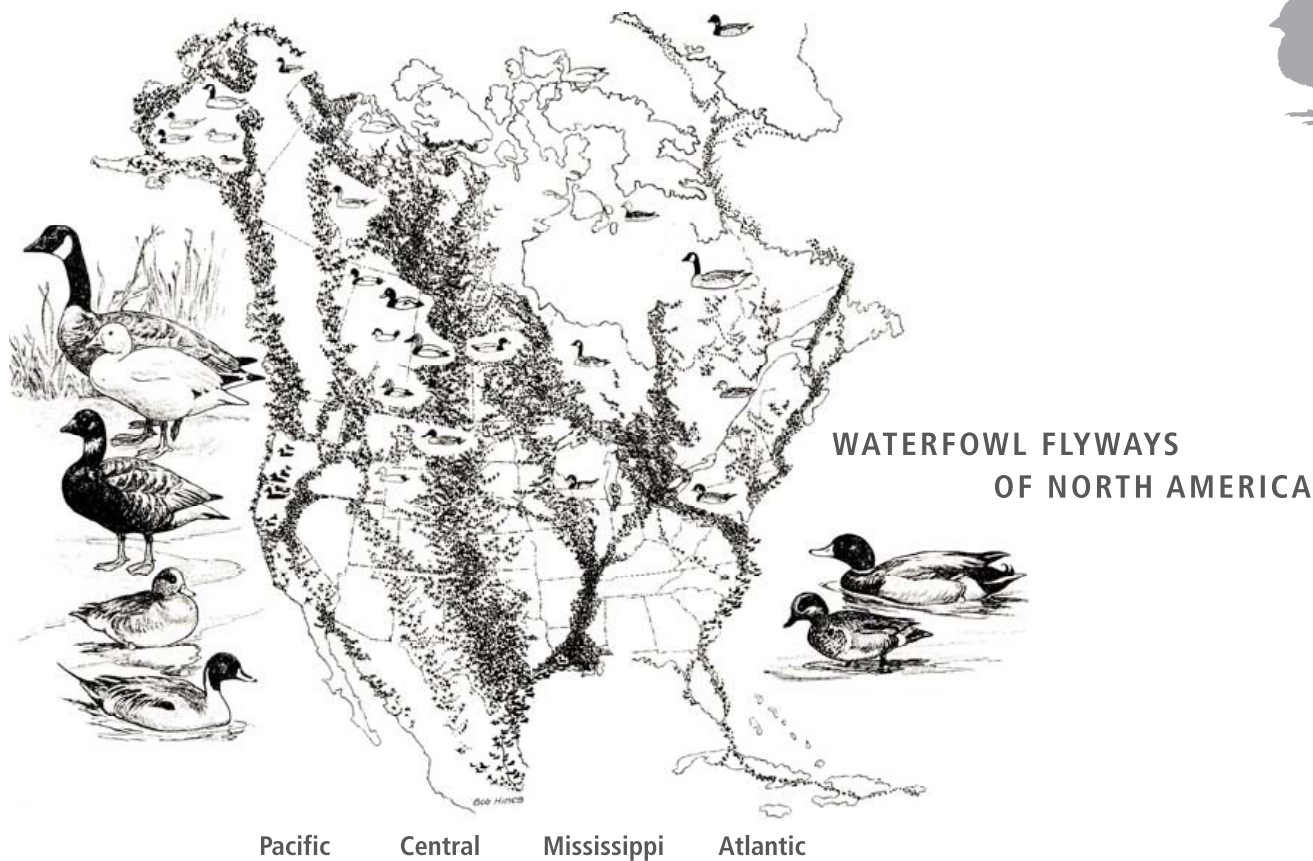
The second type, **highly pathogenic avian influenza**, is hard to miss. “High path” avian influenza spreads more rapidly than low path and has a high death rate in birds. In fact, birds that contract high path avian influenza usually die within days of getting the virus.

As mentioned previously, there are many different kinds of bird flu. Scientists organize and keep track of the differences by assigning classifiers, or categories, to each distinctive feature of each different strain of virus. AI viruses are classified by two groups of proteins found on the surface of the virus: **hemagglutinin proteins** (H), of which there are 16 known (H1-H16), and **neuraminidase proteins** (N), of which there are 9 known (N1-N9).

The strain of avian influenza that is rapidly spreading in some parts of the world is high path **Hemagglutinin #5 Neuraminidase #1** (H5N1). To date, **no** high path H5N1 has been found in North America, but other, less dangerous, low path avian influenza viruses have.



Notice the hemagglutinin and neuraminidase proteins on this illustration of a virus. Highly pathogenic H5N1 is the strain of avian influenza of current concern.



## How Do Wild Birds and Smuggling Figure Into This High Path H5N1 Picture?

### ACTIVITY

#### Waterfowl Flyways vs. Poultry-Producing States

Compare the waterfowl flyways of North America with the locations of the top 12 poultry-producing states: Arkansas, Georgia, Alabama, North Carolina, Mississippi, Texas, Maryland, Delaware, Virginia, Missouri, South Carolina, and California.

Because wild birds can carry high path H5N1 avian influenza and infect domestic birds, look at the migratory bird flyways of North America. Some birds from Europe and Asia have summer breeding grounds in Alaska and Canada where they mingle with migratory North American birds. Because Alaska is at the crossroads of bird migration flyways, scientists believe the strain of high path H5N1 avian influenza currently affecting Asia, Europe, and Africa could arrive there. As birds from Alaska and Canada begin their southerly migration from these breeding grounds, state, federal, and university biologists in the lower 48 states and Hawaii capture and sample various species under an expanded wild bird monitoring program for all national migratory bird flyways and states.

Monitoring wild birds helps keep farmers and veterinarians informed if an influenza virus is in their area.

Bringing poultry, poultry products, and other live birds and products into this country could introduce avian influenza and other diseases. To help keep avian influenza out of this country, the U.S. government enforces strict border controls and quarantines (a period of isolation to test for contagious diseases) animals at ports of entry, for example at international airports.



## How Is Poultry Important to the World's Food Supply?

Eggs and meat from poultry, which are domestic fowl (such as chickens, turkeys, ducks, or geese), are important sources of protein for much of the world. In 2003, people in China and Thailand consumed about 27 pounds of poultry per person; in France, 55 pounds; and in Malaysia, 75 pounds. The average American ate 82 pounds of poultry in 2003.

Interestingly, in countries where high path H5N1 avian influenza has been found, some people raise “**backyard flocks**” of chickens or other poultry in areas near their homes. Raising backyard flocks increases the opportunities for poultry to catch diseases carried by wild birds. In some parts of the world, small flocks are often brought inside the home at night for protection. If birds are kept inside homes, the chances of human contact with sick birds increases. This is less common in the United States where we rely more on poultry farms and grocery stores for the poultry we eat.

Most poultry in the United States is raised inside poultry houses. For decades, poultry farmers have taken extra precautions to keep diseases out of poultry houses. By keeping poultry indoors, producers can control disease among the birds and limit access to wild birds that might carry viruses.

## How Is Poultry Important to the World's Economy?

Many people throughout the world support themselves by raising poultry. The United States is the world's largest producer and exporter of poultry meat and the second-largest egg producer. U.S. poultry production is valued at \$29 billion annually.

There is concern about the economic consequences caused by outbreaks of high path H5N1 avian influenza in poultry flocks overseas. High path H5N1 avian influenza has already killed many outdoor flocks, flocks that are sources of both food and income for many small farmers.

Many farmers in countries where high path H5N1 avian influenza is found must completely eliminate, or **eradicate**, entire flocks. Even if their farms are located near an area where high path H5N1 avian influenza has killed poultry, it is often necessary to create a **quarantine** (an area surrounding the infected flock), to prevent the spread of the virus. Quarantines restrict the movement of poultry into and out of the area. Sometimes farmers also have to kill healthy birds to prevent the spread of the flu. As a result, they will not have as much food for their families, and they lose a potential source of income.



## So far, you have learned:

- What avian influenza is, specifically high path H5N1;
- How wild birds and smuggling figure into this picture;
- Why poultry is important to the world's food supply; and
- Why poultry is important to the world's economy.

Now that you have some of the background about this virus and its potential impact in the United States, let's focus on when this virus first appeared and how it has spread.

## Brief History of High Path H5N1 Avian Influenza Around the World, 1996 –2004

**1996** – High path H5N1 avian influenza caused the death of a goose at a poultry farm in a Chinese province near Hong Kong.

**1997** – Officials in Hong Kong reported additional high path H5N1 avian influenza outbreaks in poultry at farms and in open-air food markets. These outbreaks were reported to the World Organization for Animal Health in Paris, France. These outbreaks included 18 confirmed cases of high path H5N1 avian influenza in humans, which resulted in 6 deaths. These cases of infection occurred in people who had heavy, direct contact with infected birds.

**February 2003** – Two cases of high path H5N1 avian influenza were confirmed in Hong Kong in travelers who had recently returned from China, and one of them died from the virus.

**December 2003** – World Organization for Animal Health officials confirmed that high path H5N1 avian influenza had spread to South Korea, causing poultry deaths at three farms.

**January 2004** – The United Nations World Health Organization in Geneva, Switzerland, confirmed the first human patients from Vietnam as having high path H5N1 avian influenza. Within 3 months, the virus was found in Indonesia. Vietnam reported 23 human cases of infection; 16 of them died. Thailand reported 12 human cases, with 8 deaths.

Officials confirmed cases of high path H5N1 avian influenza virus in poultry flocks in Japan, Thailand, Cambodia, and Laos. Japan responded rapidly, eradicating the high path H5N1 avian influenza virus. However, in January 2007, the high path H5N1 avian influenza virus was detected again in commercial poultry. South Korea also eradicated the high path H5N1 avian influenza virus in 2004. It was considered high path H5N1-free until November 2006, when the virus was found again in several poultry farms.



**You are  
the best  
protection  
your birds  
have.**

### Practice Biosecurity

- Wash hands—everyone near your birds should wash their hands before and after leaving the birds.
- Limit contact with other birds and poultry owners and their tools and property.
- Disinfect your cars and trucks, cages, equipment after every bird event.



### Look

- Look for unusual behavior in your flock or sudden deaths of one or more birds.



### Report

- Don't be afraid to report any suspicious signs to your veterinarian, cooperative extension office, or call the USDA Veterinary Services office at 1-866-536-7593.



Two large families were among the human deaths in Vietnam. The World Health Organization considered these deaths to be of high concern because they were the first cases to have possibly involved limited spread of the virus from human to human. Public health officials were concerned because if the virus changes enough to jump easily from human to human, like a common cold, it could spread quickly and infect thousands, perhaps millions, of people around the world.

**October 2004** – Of 441 tigers in Thailand that ate raw chicken infected with high path H5N1 avian influenza, 147 died or were euthanized (put to death painlessly).

**By the end of 2004** – High path H5N1 avian influenza spread to Malaysia and infected greater numbers of poultry in countries where it had already been found.

## Things To Think About

Even though high path H5N1 avian influenza has not yet mutated, or changed, into a virus that can easily infect humans, you should know about the recent cases of infection from high path H5N1 avian influenza because:

- Some people have gotten sick or died from high path H5N1 avian influenza after extensive direct contact with infected poultry. Because this virus has spread from animals to humans, it is considered a “**zoonotic disease.**” A zoonotic disease is one that normally exists in animals but can infect humans. Rabies and plague are examples of zoonotic diseases. Health officials watch zoonotic diseases closely because they can create serious public health situations;
- Animals that ate infected birds died, showing that the virus can spread from birds to mammals if given in high amounts; and
- Some countries quickly eradicated or controlled outbreaks of high path H5N1 avian influenza, while others have struggled to teach people how to keep birds and families healthy. The more the virus infects poultry, the greater the risk that it could mutate into a virus that could infect people and spread easily.



## VOCABULARY

### words to know:

avian influenza  
high path avian influenza  
low path avian influenza  
pathogenicity  
domestic poultry  
hemagglutinin protein  
zoonotic  
eradicate  
quarantine  
backyard flocks  
flyways

## Questions and Discussion

1. Review the brief history timeline. What is significant about the high path H5N1 avian influenza infections in South Korea and Thailand?
2. If the disease occurs most often in “backyard” flocks of poultry, how can spread of the high path H5N1 avian influenza virus be stopped?
3. We know that some families in other countries struggle to keep their birds healthy. What advice could you give to help those families change their behavior so that they have healthy birds?
4. Birds use migratory routes to find places with moderate temperatures during the winter. Which flyways would migratory birds use to pass through North America?

## ACTIVITY



### For Your Map...

- Shade in China, South Korea, and Thailand on the world map with one color. Label these areas as “2003” (even though some cases of the disease were discovered earlier than 2003, this is the year when the virus began to spread).
- Shade in the countries where the virus was reported in 2004 differently than those of 2003 and label these countries “2004.”



### For Your Notebook...

- Record in your notebook what you think the threat might be at the end of 2004 in the United States. What steps, if any, would you recommend to state and local government and public health officials at the end of 2004 to protect the public?



Take common-sense steps to limit the spread of germs. Make good hygiene a habit.

- Wash hands frequently with soap and water.
- Cover your mouth and nose with a tissue when you cough or sneeze.
- Put used tissues in a wastebasket.
- Cough or sneeze into your upper sleeve if you don't have a tissue.
- Clean your hands after coughing or sneezing. Use soap and water or an alcohol-based hand cleaner.
- Stay at home if you are sick.

It is always a good idea to practice good health habits.

- Eat a balanced diet. Be sure to eat a variety of foods, including plenty of vegetables, fruits, and whole grain products. Also include low-fat dairy products, lean meats, poultry, fish, and beans. Drink lots of water and go easy on salt, sugar, and saturated fat.
- Exercise on a regular basis and get plenty of rest.

## How Does Seasonal Flu Compare to High Path H5N1 Avian Flu?

**Seasonal (or common) flu** in humans is a respiratory illness that can be transmitted from person to person. Most people have some immunity and a vaccine is available. The illness usually passes from one person to another because these viruses infect the nose and throat and are easily spread when a person coughs or sneezes and does not wash his or her hands.

**Avian (or bird) flu** is caused by influenza viruses that occur naturally among wild birds. The high path H5N1 avian influenza strain is deadly to birds and can be transmitted from birds to humans. There is no human immunity and no vaccine is available. Scientists believe that even though high path H5N1 avian influenza spreads quickly and is deadly among birds, it has *not* mutated into a form that easily infects humans. However, the number of high path H5N1 avian influenza cases in humans has doubled to more than 250 cases in 10 countries, indicating that it is possible for people to get the virus if they have extensive direct contact with infected birds. Tragically, more than half of the known infected people have died.

**Pandemic flu** is a virulent (or extremely able to cause disease) human flu that causes a global outbreak, or pandemic, of serious illness. Because there is little natural immunity, the disease can spread easily from person to person. Currently, there is *no* pandemic flu anywhere in the world. In the past year, high path H5N1 avian influenza has spread to more than 40 additional countries and has led to the deaths of hundreds of millions of birds, which has heightened concern about the possibility of the virus mutating and creating a human flu that could be deadly. When a deadly virus spreads easily from human to human, it is called a human pandemic. History tells us that human influenza pandemics can infect and kill millions of people.

Scientists and governments have been watching closely for changes in the high path H5N1 avian influenza virus to help prevent a pandemic. A pandemic occurs when many people in many different areas get sick from the same virus at the same general time because their bodies are unable to fight off the virus. For example, the 1918 “Spanish flu” was one of the most severe pandemics in modern history.





## Pandemics since 1900

**Historical Overview:** History suggests that influenza pandemics have probably happened during at least the past four centuries. Since 1900, three pandemics and several “pandemic threats” have occurred.

### 1918: Spanish Flu

The Spanish Influenza pandemic is the catastrophe against which all modern pandemics are measured. Approximately 20 to 40 percent of the world-wide population became ill and more than 50 million people died. Between September 1918 and April 1919, approximately 675,000 deaths from the flu occurred in the United States. Many people died quickly; some people who felt well in the morning became sick by noon, and were dead by nightfall. Those who did not succumb to the disease within the first few days often died of complications (such as pneumonia) caused by bacteria. One of the most unusual aspects of the Spanish flu was its ability to kill young adults. The reasons for this remain uncertain. With the Spanish flu, mortality rates were high among healthy adults as well as the usual high-risk groups. The attack rate and mortality were highest among adults 20 to 50 years old. The severity of that virus has not been seen again.

### 1957: Asian Flu

In February 1957, the Asian influenza pandemic was first identified in the Far East. Immunity to this strain was rare in people less than 65 years of age, and a pandemic was predicted. In preparation, vaccine production began in late May 1957, and health officials increased surveillance for flu outbreaks. Unlike the virus that caused the 1918 pandemic, the 1957 pandemic virus was quickly identified, due to advances in scientific technology. Vaccine was available in limited supply by August 1957. The virus came quietly to the United States, with a series of small outbreaks during the summer of 1957. When American children went back to school in the fall, they spread the disease in classrooms and brought it home to their families. Infection rates were highest in October 1957 among schoolchildren, young adults, and pregnant women. Most influenza-and pneumonia-related deaths occurred between September 1957 and March 1958. The elderly had the highest rates of death.

By December 1957, the worst seemed to be over. However, during January and February 1958, there was another wave of illness among the elderly. This is an example of the potential “second wave” of infections that can develop during a pandemic. The disease infects one group of people first, infections appear to decrease and then infections increase in a different part of the population. Although the Asian flu pandemic was not as devastating as the Spanish flu, about 69,800 people died in the United States.

### 1968: Hong Kong Flu

In early 1968, the Hong Kong influenza pandemic was first detected in Hong Kong. The first cases in the United States were detected as early as September of that year, but illness did not become widespread in this country until December. Deaths from this virus peaked in December 1968 and January 1969. Those over the age of 65 were most likely to die. The same virus returned in 1970 and 1972. The number of deaths between September 1968 and March 1969 for this pandemic was 33,800, making it the mildest pandemic in the 20th century. There could be several reasons why fewer people in the United States died due to this virus. First, the Hong Kong flu virus was similar in some ways to the Asian flu virus that circulated between 1957 and 1968. Earlier infections by the Asian flu might have provided some immunity against the Hong Kong flu, which may have helped reduce the severity of illness during the Hong Kong pandemic. Second, instead of peaking in September or October, as pandemic influenza had in the previous two pandemics, this pandemic did not gain momentum until near the school holidays in December. Since children were at home and did not infect one another at school, the rate of influenza illness among schoolchildren and their families declined. Third, improved medical care and antibiotics that are more effective for secondary bacterial infections were available for those who became ill.

Source: [www.pandemicflu.gov](http://www.pandemicflu.gov)



## How Does an Avian Influenza Virus Mutate and Evolve?

In order for a pandemic to occur, the high path H5N1 avian influenza virus would have to undergo a **mutation**, or change.

One type of mutation enables a flu strain to jump from one animal species to another, including humans. For example,

- A duck or other aquatic bird passes an avian strain of influenza to an intermediate host such as a pig.
- A person passes a human strain of influenza to the same pig.
- As the different viruses infect the same cell, the genes from the bird strain mix with genes from the human strain to yield a new, hybrid virus.
- The new strain could then spread from the intermediate host, such as the pig in this example, to humans.

Another type of mutation is possible when small changes occur over time. If this happens, the human body would not be able to fight the infection as it would other flu viruses, because the body's immune system would not recognize the new virus.

Because these two types of mutations are possible, a new virus strain might further develop to spread easily from person to person. The potential for a deadly flu virus that could spread like the common cold is the reason many scientists and governments are monitoring high path H5N1 avian influenza so closely. However, it is important to remember that there is currently no human pandemic.



### So far, you have learned:

- The differences between seasonal, avian, and pandemic flu;
- A brief history of pandemics; and
- How an avian influenza virus can mutate into a strain that could start a pandemic flu.



## Brief History of High Path H5N1 Avian Influenza Around the World, 2005

**January 2005** – World Health Organization officials confirmed that a case of high path H5N1 avian influenza transmission between people occurred in 2004, when a mother in Thailand contracted the virus from her daughter. Officials believe this might be the first confirmed case of human-to-human transmission.

**April 2005** – China reported high path H5N1 avian influenza in wild ducks and geese. Within a month, more than 6,000 birds of several species were found dead near Qinghai Lake in central China, a usual stop in their spring migration northward.

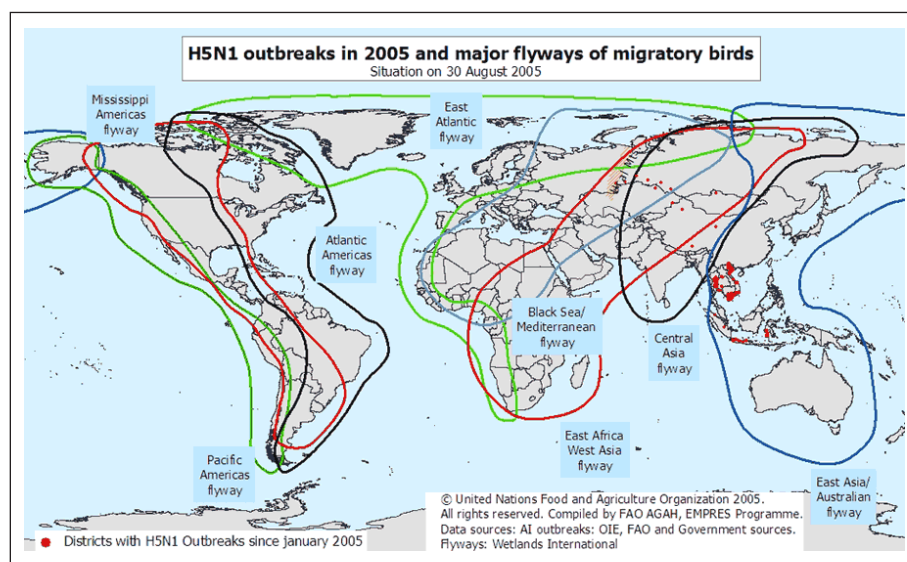
**July 2005** – High path H5N1 avian influenza was found in poultry in western Siberia and Kazakhstan. Additional migratory birds were found dead near the Siberian outbreak.

**August 2005** – Mongolia reported the virus in migratory birds at two lakes.

**September 2005** – High path H5N1 avian influenza was found in poultry in Tibet.

**October 2005** – Taiwan reported the detection of high path H5N1 avian influenza in a cargo of exotic songbirds smuggled from mainland China.

**End of 2005** – The virus was confirmed in poultry or wild birds in Turkey, Romania, Croatia, Ukraine, and Kuwait.



## VOCABULARY

### words to know:

seasonal flu  
virulent  
avian flu  
pandemic flu  
mutation

## ACTIVITY



### For Your Map...

- Shade in and label the countries that had cases confirmed in 2005. Does the pattern of infection suggest anything to you about how the virus is spreading?



### For Your Notebook...

- Record in your notebook what other actions, if any, you would have recommended to officials to protect the public in the United States at the end of 2005.

## Things To Think About

- The confirmed case of human-to-human transmission of high path H5N1 avian influenza in Thailand and the massive die-off of migratory birds in China are significant events in understanding how this virus is evolving. The human-to-human case signals the first official confirmation that this virus has jumped from a bird to a human and then passed to another human. While the transmission was not sustained, it marks a change in the makeup of the virus. The migratory bird die-off signals the first time that this virus has infected and killed a significant number of wild birds. In previous years, the large die-offs were associated with poultry.
- Many scientists are becoming increasingly concerned that this high path H5N1 avian influenza virus could mutate into a strain that could easily spread between humans. It is important to understand that while there is concern, currently there is no pandemic.
- Because high path H5N1 avian influenza has spread from infected birds to humans after extensive direct contact, it is possible for the virus to change or mutate even more than it already has since it first appeared in 1996.

## Questions and Discussion

1. Why are government officials concerned about a virus that affects mostly birds?
2. Pandemics, while rare, have occurred throughout recorded history. Of the known pandemics, which have been the most deadly?
3. While the high path H5N1 avian influenza virus has not entered the United States, what could you do now to educate the public about the virus? What could you, as a government official, do to keep it out of this country?

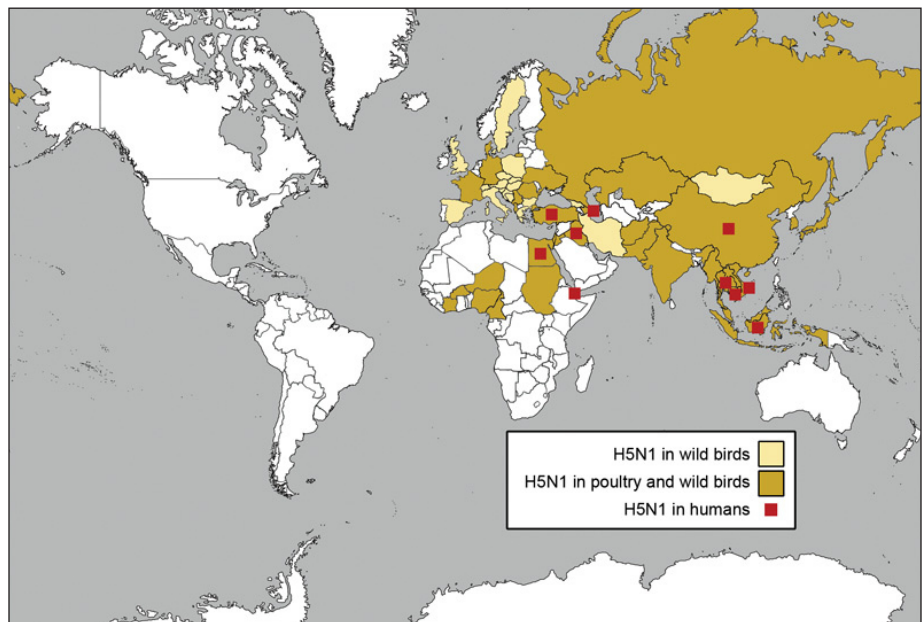


## What Is The United States Doing To Protect Itself From High Path H5N1 Avian Influenza?

By mid-2006, more than 50 countries had confirmed the presence of high path H5N1 avian influenza. The U.S. government works to protect U.S. poultry by monitoring strains of avian influenza in wild birds, so that wild birds migrating here from other countries do not infect our commercial flocks. Finding the virus early is one of our best defenses. This helps protect the health of our poultry and ensures the safety of our food supply.

Even though high path H5N1 avian influenza has not been found in the United States, federal and state governments continue to monitor as the virus spreads overseas. Federal and state government veterinarians, specially trained to diagnose animal diseases, regularly test for high path H5N1 avian influenza. Our governments are also working on high path avian influenza rapid response plans, should the virus come to our shores. The U.S. government also helps other countries with tests and techniques on how to eradicate the virus.

### NATIONS WITH CONFIRMED CASES OF HIGH PATH H5N1 AVIAN INFLUENZA IN JULY 2006





## Avian Influenza And The Food Supply – How Safe Is It?

As mentioned in the other stages, the spread of the virus in humans overseas has been a result of extensive, direct contact with infected birds. Not only should the people who live in the high path H5N1 avian influenza-affected countries and/or regions take precautions to protect the health of their birds, but they also should take precautions to protect themselves.

Scientists have learned that the high path H5N1 avian influenza virus infects poultry meat. In some countries, it is customary for people to consume undercooked poultry or blood (for example, duck blood soup).

Scientists have proven that cooking poultry meat to 165°F kills the high path H5N1 avian influenza virus. Cooking eggs until they are firm throughout also kills the AI virus.

So, it's very important to make sure that all poultry meat and eggs are properly handled and cooked. It also is important to note that there are no documented cases of virus transmission through properly prepared and cooked poultry and eggs.

High path H5N1 avian influenza has **not** been detected in the United States. Should the virus be detected here, the chance of infected poultry or eggs entering the food chain is extremely low because of the rapid onset of symptoms and death in poultry and the safeguards in place, which include the testing of flocks and federal inspection programs. Cooking poultry, eggs, and other poultry products to the proper temperature and preventing cross-contamination between raw and cooked food is the key to safety.



### So far, you have learned:

- Why the government is watching the spread of the high path H5N1 avian influenza virus closely;
- How the high path H5N1 avian influenza virus affects poultry meat; and
- How proper handling and cooking kill the virus.



#### Clean.

Wash hands, utensils, and cutting boards before and after contact

with raw meat, poultry, seafood, and eggs.

#### Separate.

Keep raw meat and poultry apart from foods that won't be cooked.



#### Cook.

Use a food thermometer; you can't tell food is cooked safely by how it looks.

#### Chill.

Chill leftovers and takeout foods within 2 hours and keep the fridge at 40°F or below.



Food-handling safety risks are more common than most people think. The four easy lessons of Clean, Separate, Cook, and Chill can help prevent harmful bacteria, viruses, and other foodborne germs from making you or your family sick.

From: [befoodsafegov](http://befoodsafegov)



Number of confirmed cases of H5N1 in humans by year since 2003\*

year	cases	deaths
2003	4	4
2004	46	32
2005	97	42
2006	116	80
2007	8	7
total	271	165

\* Cases confirmed by WHO February 2007

## Brief History of High Path H5N1 Avian Influenza Around the World, 2006

**January through July 7, 2006** – High path H5N1 avian influenza infection in poultry or wild birds was confirmed in the following previously unaffected countries: Iraq, Nigeria, Azerbaijan, Bulgaria, Greece, Italy, Slovenia, Iran, Austria, Germany, Egypt, India, France, Hungary, Slovakia, Bosnia-Herzegovina, Georgia, Niger, Djibouti, Switzerland, Serbia-Montenegro, Poland, Albania, Cameroon, Myanmar, Denmark, Sweden, Afghanistan, Israel, Pakistan, Jordan, the Palestinian Autonomous Territories, the Czech Republic, Burkina Faso, Ivory Coast, Sudan, Spain, and the United Kingdom.

In addition to poultry and wild birds, these countries had some confirmations of the disease in cats, stone marten (a ferret-like animal), and mink.

**Mid-July 2006 – The 1996** outbreak of high path H5N1 avian influenza first reported in China was confirmed in birds across most of Asia, Europe, and Africa. The path of the disease had followed the flyway patterns of migratory birds and the routes used in bird smuggling or in the trading of poultry and poultry products.

**November 2006** – High path H5N1 avian influenza outbreaks recur in South Korea on several farms for the first time since it was initially eradicated in 2004.

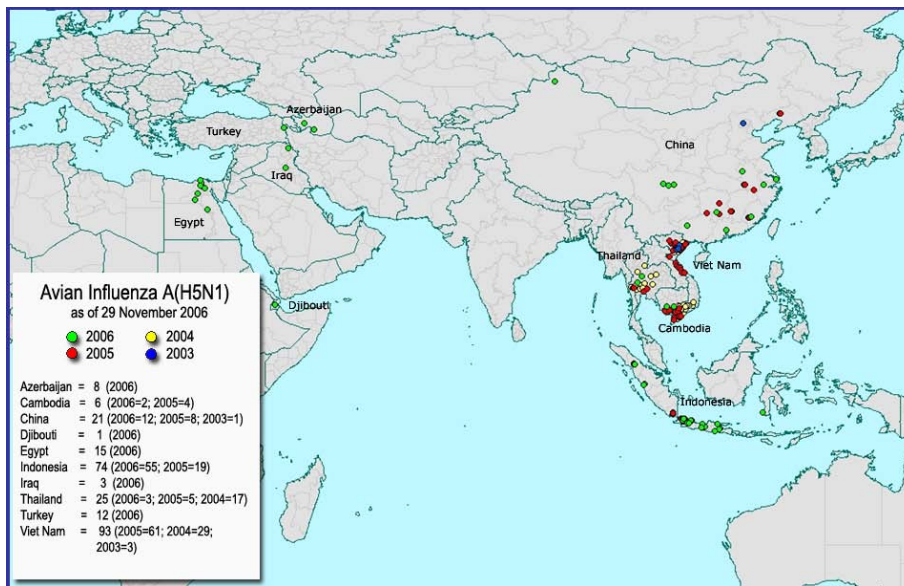
## Things To Think About

- The high path H5N1 avian influenza virus spread quickly through parts of Europe, carried by migratory birds in 2006.
- According to the World Health Organization, there have been 271 confirmed cases of humans with the avian influenza virus since December 2003, when HPAI H5N1 was first identified in humans. These 271 cases have resulted in 165 deaths. The table at left lists the number of confirmed cases by year since 2003.



This World Health Organization map illustrates, by year and country, the breakdown of confirmed human high path H5N1 avian influenza cases.

From: [www.wpro.who.int/sites/csr/data/data\\_Maps.htm](http://www.wpro.who.int/sites/csr/data/data_Maps.htm)



Disclaimer: The presentation of material on the maps contained herein does not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or areas or its authorities of its frontiers or boundaries.

## ACTIVITY



### For Your Map...

- Shade in the remaining countries that have had confirmation of the virus and label them as 2006



### For Your Notebook...

- Review your notebook from the beginning of this avian flu activity. Consider what you first thought about the possible health threat posed by the virus and what you have learned about it over the course of this activity. Determine if your opinion changed as you learned more information about the virus, and record this along with your final analysis of the potential for mutation of the high path H5N1 avian influenza virus.

## Questions and Discussion

- Look at the map above and note the number of countries affected by high path H5N1. We know that this virus has existed since 1996. Why do you think this virus has not reached the United States after 10 years, especially after it spread so quickly in 2006 throughout parts of Europe via migratory birds?
- In Stage One, the importance of poultry to the food supply was discussed. In this chapter, you learned that cooking poultry to an internal temperature of at least 165°F kills this virus as well as all other food-borne germs. What messages could you suggest to the American public to reassure them that U.S. poultry is safe to eat?
- What would you tell people who are traveling to countries and/or regions where high path H5N1 avian influenza has been detected?





## Glossary

**Definitions taken from:** [www.pandemicflu.gov/glossary/index.html](http://www.pandemicflu.gov/glossary/index.html)

And from [www.usda.gov/birdflu](http://www.usda.gov/birdflu)

**Biosecurity:** Precautions farmers can take to reduce the risk of introducing high path H5N1 avian influenza, or other infectious diseases, into an animal population.

**Eradicate:** To destroy or get rid of the avian influenza virus completely, usually by killing entire poultry flocks where the virus is found.

**FAO:** The Food and Agriculture Organization of the United Nations, based in Rome, Italy, assists in agricultural production and animal health around the world, especially in developing countries.

**Hemagglutinin:** An important protein found on the surface of the avian influenza virus. This essential gene distinguishes H5N1 from other strains of avian influenza. There are 16 different hemagglutinin (h1-h16) proteins.

**Highly pathogenic avian influenza:** “High path” avian influenza is often fatal in chickens and turkeys. It spreads more rapidly than “low path” avian influenza and has a high death rate in birds. High path H5N1 avian influenza is the type spreading rapidly in some parts of the world. It is of growing concern for human and animal health.

**Influenza:** A serious disease caused by viruses that infect the respiratory tract or lungs of humans and animals.

**Low pathogenic avian influenza:** Most avian flu strains are classified as “low path” and typically cause few or no signs of illness in infected birds. Low path avian influenza generally does not pose a significant health threat to humans.

**Mutation:** Any change in a gene from its natural state. Specific mutations and evolution in avian influenza viruses cannot be predicted, making it difficult — if not impossible — to know if or when a virus such as high path H5N1 avian influenza might change to spread easily among humans.

**Neuraminidase:** An important protein on the surface of avian influenza viruses and an essential enzyme for the spread of the virus throughout the respiratory tract. It is the second half of the classification system that allows scientists to track various strains of avian influenza. There are nine neuraminidase proteins (n1-n9).

**OIE (Office International des Epizooties):** The World Organization for Animal Health, based in Paris, France, is responsible for assuring that trade in animals and animal products between countries is conducted properly, so that transmission of animal and zoonotic diseases across national borders does not occur.

**Pandemic:** The worldwide outbreak of a disease in numbers clearly in excess of normal. Because there is little natural immunity, the disease can spread easily from person to person. Currently, there is no pandemic.

**Pathogenic:** Causing disease or capable of doing so.

**Poultry:** Domestic fowl, such as chickens, turkeys, ducks, or geese, raised for meat or eggs.

**Strain:** A group of organisms within a species or variety.

**Virus:** Any of various simple submicroscopic parasites of plants, animals, and bacteria that often cause disease and that consist essentially of a core of RNA or DNA surrounded by a protein coat. Unable to replicate without a host cell, viruses are typically not considered living organisms.

**Zoonotic disease:** A disease that normally exists in animals, but can infect humans. Rabies and plague are examples of zoonotic diseases.

**WHO:** World Health Organization, an agency of the United Nations established in 1948 to further international cooperation in improving health conditions around the world.

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United States  
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State Research,  
Education,  
and Extension  
Service

## UNDERSTANDING AVIAN INFLUENZA

### Highlights

- This activity is designed for high school science students to aid in developing their understanding of the following National Science Education Standards:
  - *Content Standard A: Scientific Inquiry*
  - *Content Standard C: Life Science*
  - *Content Standard F: Science in Personal and Social Perspectives*
  - *Content Standard G: History and Nature of Science*
- This activity will also help develop problem-solving skills and will facilitate student discussion and interaction. Adjustments to accommodate different grade levels are easy to accommodate.
- The lesson plan is divided into three sections. Each section represents a different period of time: 1996–2004, 2005, and 2006. Each timeframe is subdivided into three short elements: Background, Brief History, and Things to Think About. Background sections include scientific information about avian influenza relevant to the development of the disease. The Brief History sections lay out what was known about highly pathogenic H5N1 avian influenza. The Things To Think About sections have additional information that students can use to make determinations about the seriousness of the virus.
- At the end of each step, students identify the countries by the year the virus was confirmed. Using a world map will help students see the progress of the virus. At the end of each timeframe, they will record their thoughts about how serious they believe the threat from the virus is to the United States. This record will help you determine how well the students understand the issue.
- A world map and glossary are included in the attachments. Words in bold-face are contained in the glossary. A complete glossary is available on the U.S. Pandemic Flu Web site: <http://www.pandemicflu.gov/glossary.html>
- This lesson was compiled in November 2006. The information in the activity is based on the information available at that time. Stage Three in the activity ends at that time and contains a chart with the number of confirmed human deaths by country and year. WHO reports only confirmed cases and fatalities of HPAI H5N1. Check for updates at its Web site: [http://www.who.int/csr/disease/avian\\_influenza/en/index.html](http://www.who.int/csr/disease/avian_influenza/en/index.html). The WHO Web site also contains a timeline showing when the virus was detected by country and by year.

# INSTRUCTOR'S GUIDE: UNDERSTANDING AVIAN INFLUENZA



## Background

S ometime in the past year or two, you probably have heard about “bird flu.” It has been in the news because the highly pathogenic, or deadly, H5N1 avian influenza virus has infected domestic poultry and wild birds in Asia, Europe, and Africa. This virus has killed both birds and people in Asia and Africa.

The aim of this lesson, *Understanding Avian Influenza*, is to explain to students the many reasons why they should know about the virus and what it means if it does show up in the United States.

While high path H5N1 has not been found anywhere in the United States, the rest of North America, Central, or South America, it is possible that it could be. Government officials around the world are watching this virus closely and working to slow its spread.

Although there are significant differences in the way poultry is raised in the United States from how it is raised in much of the rest of the world, U.S. public health officials are preparing as if this particular bird flu could arrive here.

## Objectives

The students will learn:

- Why public health experts around the world are watching this highly pathogenic H5N1 avian influenza virus carefully;
- A brief history of avian influenza;
- The importance of poultry as a source of protein for much of the world;
- Where the majority of poultry is raised in the United States and how poultry producers work to keep it disease-free;
- Why we need to prepare in the United States for the possible arrival of the highly pathogenic H5N1 bird flu now that it is infecting millions of birds overseas;
- How influenza viruses develop and how this particular strain of the avian flu virus is spread;
- Where the virus has struck and what has happened as a result; and
- What a human pandemic is and why the arrival of this strain of avian influenza in the United States would not signal the start of a human pandemic.

# INSTRUCTOR'S GUIDE: UNDERSTANDING AVIAN INFLUENZA



## ACTIVITIES



### For the world map...

At the end of each stage, the students will be asked to color in a blank world map to track the spread of the highly pathogenic H5N1 avian influenza virus. Suggestion: Students also could be asked to break out the spread between poultry, wild birds, and humans.



### For the notebook...

The students should keep a notebook to record their recommendations in each of the three timeframes. At the end of each stage you should ask the students to record their opinions about how serious they think the threat to public health in the United States was at that time.

### Materials Needed

- Notebook
- Colored pencils
- World map graphic – black and white
- United States map
- *Biosecurity for Birds* campaign material – [www.usda.gov/birdflu](http://www.usda.gov/birdflu)
- *Be Food Safe* campaign material – [www.befoodsafe.gov](http://www.befoodsafe.gov)
- USDA *Avian Influenza* brochure – [www.usda.gov/birdflu](http://www.usda.gov/birdflu)

## Focus

In this activity, the students should assume that they are U.S. government or public health officials who are monitoring the spread of the highly pathogenic H5N1 avian influenza virus over a period of years. You should ask the students to discuss what they have learned in each phase of the activity. You also should ask them to develop some recommendations to protect the population of birds and people in the United States if this virus does arrive here.

## Activity Stages

The Understanding Avian Influenza lesson plan is divided into three stages to illustrate what was known about the highly pathogenic H5N1 avian influenza virus when it first appeared, and how it has evolved during the past 10 years.

Specifically, to help students better understand the potential threat of this virus to animals in the United States:



### Stage One:

- Provides an overview on avian influenza as an animal health disease;
- Explains how wild birds and smuggling figure into the high path H5N1 avian influenza picture;
- Describes how poultry is important to the world's food supply;
- Shows how poultry is important to the world's economy; and
- Provides a brief history of high path H5N1 avian influenza around the world between 1996 and 2004.

At the end of this stage, the students will have the information that was known about this deadly strain of avian flu in December 2004.



### Stage Two:

- Explains the differences between seasonal, avian, and pandemic flu;
- Provides a brief history of pandemics since 1900;
- Describes the mutation and evolution of the high path H5N1 avian influenza strain; and
- Provides a brief history of high path H5N1 avian influenza around the world in 2005.



### Stage Three:

- Explains briefly how the U.S. government works to protect U.S. poultry;
- Explains avian influenza and the food supply; and
- Provides a brief history of high path H5N1 avian influenza around the world in 2006.

# INSTRUCTOR'S GUIDE: UNDERSTANDING AVIAN INFLUENZA



## Additional Information:

### Stage One

This information is available from the USDA “Avian Influenza: Protecting the United States” brochure, which is posted on the USDA Web site at [www.usda.gov/birdflu](http://www.usda.gov/birdflu).

#### Wild birds

- Expanded wild bird testing serves as an early warning system. USDA has been testing wild migratory birds for high path H5N1 since 1998 in both Alaska and the Atlantic flyway. USDA officials have worked with federal, state, and academic partners to enhance testing and develop a national strategic plan for the early detection of high path H5N1.
- The wild bird plan targets those bird species in North America at the highest risk because of their migratory patterns. Key species of interest include ducks, geese, and shorebirds. USDA and its partners plan to collect approximately 100,000 samples from wild birds and 50,000 samples from waterfowl habitats across the United States annually.
- The wild bird plan recommends a prioritized sampling system, with emphasis first in Alaska, the Pacific flyway, and on the Pacific islands, and followed by the Central, Mississippi, and Atlantic flyways.

#### Smuggling

- The U.S. government is protecting domestic poultry flocks in many ways. The first is by prohibiting imports of poultry and poultry products from countries and/or regions where high path H5N1 avian influenza virus has been confirmed in domestic or traditionally raised flocks (not wild birds). Imports of wild bird species and wild bird parts and products must comply with U.S. government-enforced conservation laws and treaties.

- USDA quarantines and tests live birds imported into the United States to ensure that they do not have any foreign animal diseases, such as the high path H5N1 avian influenza virus.
- All imported live birds and returning U.S.-origin pet birds (except from Canada) must spend 30 days at a USDA quarantine facility where they are tested for the avian influenza virus before entering the country.
- USDA maintains trade restrictions on the importation of poultry and poultry products originating from countries and/or regions where the high path H5N1 avian influenza virus has been detected in commercial or traditionally raised poultry. USDA regulations require that import permits accompany properly sanitized poultry products, such as raw feathers.
- USDA, in coordination with the U.S. Department of Homeland Security - Customs and Border Protection, has increased its monitoring for illegally smuggled poultry and poultry products through an anti-smuggling program.

#### Protecting backyard birds

- Encourage owners of backyard bird flocks to strengthen biosecurity practices to keep diseases out of their birds. Biosecurity practices are steps that people can take to reduce the risk of introducing an infectious disease into an animal population.
- For example, backyard flock owners and pet bird owners should keep their birds' cages clean, know the warning signs of bird disease (such as avian influenza), and not bring in new birds to their flocks without proper testing to make sure they are avian influenza-free. An outbreak of a bird disease

such as highly pathogenic avian influenza not only could harm your birds, it could kill other nearby birds and quickly spread through your flock.

- Many strains of avian influenza can cause varying amounts of clinical illness in poultry. Birds affected by AI may show swelling of the head and face.

USDA recommends that owners of backyard flocks follow these six tips to prevent poultry disease:

- Keep your distance (restrict access to your property and your birds);
- Practice backyard biosecurity and do not mix species of birds together. Allowing a backyard flock to mix with wild waterfowl poses the risk of introducing AI into poultry;
- Keep it clean (clean and disinfect your clothes, shoes, equipment, and hands);
- Don't haul disease home (if you have been near other birds or bird owners, clean and disinfect poultry cages and equipment before going home);
- Don't risk disease from your neighbor (do not borrow lawn and garden equipment, tools, or poultry supplies from other bird owners); and
- Know the warning signs (sudden increase in bird deaths; sneezing; coughing; nasal discharge; watery or green diarrhea; lack of energy; poor appetite; drop in egg production; swelling around the eyes, neck, and head; and purple discoloration of wattles, combs, and legs). Report sick birds (call your local or state veterinarian, or call USDA's Veterinary Services toll-free at 866-536-7593).

*(see next page for additional Stage 2 and Stage 3 information)*

# INSTRUCTOR'S GUIDE: UNDERSTANDING AVIAN INFLUENZA



## Stage Two

Information about human pandemics is available at [www.pandemicflu.gov](http://www.pandemicflu.gov).

## Stage Three

### Government Actions To Protect The U.S. Poultry Population

- If high path H5N1 avian influenza is found in domestic poultry, the USDA will work with states and industry to respond quickly and decisively following these five basic steps:
  - 1) *Quarantine* – restrict movement of poultry and poultry-moving equipment into and out of the control area;
  - 2) *Eradicate* – humanely kill the poultry flocks in the control area;
  - 3) *Monitor* – test for HPAI virus within the control area;
  - 4) *Disinfect* – sanitize the poultry houses to kill the virus; and
  - 5) *Test* – test the area to confirm that the poultry farm is AI virus-free.

### Avian Influenza and the Safety of the Food Supply

- Properly prepared and cooked poultry and eggs are safe to eat. Avian influenza is not transmissible by eating properly prepared and cooked poultry and eggs. Cooking poultry to an internal temperature of 165 °F kills avian influenza viruses, bacteria, and other viruses.
- Cooking poultry, eggs, and other poultry products to the proper temperature and preventing cross-contamination between raw and cooked food is the key to safety. You should:
  - Wash hands with warm water and soap for at least 20 seconds before and after handling raw poultry and eggs;
  - Prevent cross-contamination by keeping raw poultry and eggs away from other foods;
  - After cutting raw meat, wash cutting board, knife, and countertops with hot, soapy water;
  - Sanitize cutting boards by using a solution of 1 tablespoon chlorine bleach in 1 gallon of water; and
  - Use a food thermometer to ensure poultry has reached the safe internal temperature of at least 165 °F to kill foodborne germs that might be present, including the AI viruses.

## Sources of Additional Information:

### U.S. Government Sources

U.S. government efforts on avian influenza and human pandemic preparedness:  
[www.pandemicflu.gov](http://www.pandemicflu.gov)

U.S. Department of Agriculture efforts to protect against and respond to bird flu, and current listing of countries/areas affected with highly pathogenic H5N1 avian influenza:  
[www.usda.gov/birdflu](http://www.usda.gov/birdflu)

U.S. Department of the Interior  
[www.doi.gov](http://www.doi.gov)

U.S. Fish and Wildlife Service  
[www.fws.gov](http://www.fws.gov)

### Report Sick Farm Birds

If your farm birds are sick or dying, call your state veterinarian or local extension agent, or call USDA's Veterinary Services toll free: **(866) 536-7593**.

### Report Dead Wild Birds

Call state or federal wildlife agencies to report dead wild birds. Information on how to make contact with wildlife officials in your state is available at [www.usda.gov/birdflu](http://www.usda.gov/birdflu), or by calling the USDA Wildlife Services toll-free number: **(866) 4-USDA-WS**.

### Safe Food Preparation:

USDA Meat and Poultry Hotline: **888-MPHotline (888-674-6854)**, TTY: **800-256-7072** (available in English and Spanish). Online answers are provided at [www.fsis.usda.gov](http://www.fsis.usda.gov) by clicking on "Ask a food safety question."

### World Map

[http://go.hrw.com/atlas/norm\\_htm/world.htm](http://go.hrw.com/atlas/norm_htm/world.htm)

The U.S. Geological Survey's Alaska Science Center maintains an avian influenza Web site about its current research on avian influenza and maps of bird migration flyways:  
[http://abscweb.wr.usgs.gov/science/biology/avian\\_influenza/flyways.html](http://abscweb.wr.usgs.gov/science/biology/avian_influenza/flyways.html)

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