

## Agricultural Science Course



Under Agricultural Science Core **Standard 3**- Students will understand impacts of agriculture on society.

New **Objective**: Students will recognize the risks of working in agriculture.

**Learning goal**: Describe respiratory illnesses and risks from working in agriculture. Demonstrate proper protection techniques to prevent these illnesses.

### **Student Learning Objectives:**

1. Describe simple methods to protect respiratory health.
2. Identify the signs and symptoms of Farmer's lung.
3. Explain the difference between Toxic Organic Dust Syndrome (TODS) and farmer's lung.
4. Define work-related asthma.

### **List of resources:**

National Ag Safety Database  
Utah Department of Health Asthma Program  
Lab activity adapted from PBS

### **List of equipment, tools, supplies and facilities:**

Writing Surface  
Overhead Projector  
Picture of human respiratory anatomy  
Copies of student lab sheets  
Materials for lab

### **Terms:**

Farmer's Lung  
Toxic Organic Dust Syndrome  
Work-related asthma  
Alveoli  
Inflammation  
Chronic

**Interest Approach**: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here:

Farmers account for more than 30 percent of adults disabled by respiratory illness. (National Ag Safety Database)

## Summary of Content and Teaching Strategies:

**Objective 1:** Describe methods to protect respiratory health.

**Anticipated Problem:** What is respiratory health?

The respiratory system consists of your nose, mouth, trachea (windpipe), bronchi, lungs, alveoli and the diaphragm. Alveoli are the small air sacks in the lower lungs where gas exchange occurs. Oxygen is taken into the body through the mouth or nose, absorbed into the lungs, and then transported through the body in the blood. When working in agriculture there are many factors that can prevent the respiratory system for working right including mold and dust.

To protect your respiratory system from the damage mold and dust can cause:

1. Harvested crops such as hay and grains should be dry when stored (14% moisture content). Hay with a high risk of spoilage should be stored in silage instead of being baled. Ventilate areas where bales are being opened and wear respiratory protection when doing so.
2. Sprinkling one liter of water onto the cut side of the bale immediately before opening or chopping it to reduce airborne molds and dusts.
3. Indoor humidity should be maintained below 80% to reduce air borne organisms. Rotating crops will help to decrease fungal growth.
4. Fungi and dust from grain and animal confinement can be eliminated by using pellet feed rather than dusty chopped feed, or by substituting silage for hay.
5. When cleaning use a wet process, meaning sprinkle water on the area to be cleaned to prevent dust and other particles from becoming airborne when you sweep or wipe.
6. Use a fork to spread out open bales rather than doing it manually.
7. Moisten the top layer of silage before opening it.
8. In the fields, lower the speed of equipment to reduce the release of fine particles.
9. Organize equipment and work practices so that any prevailing wind can carry the dust away from your face.
10. Provide as much ventilation as possible when working in dusty areas. For example, make sure doors and windows are open. (National Ag Safety Database)

In some cases, it is best to wear a respirator. Make sure that it is an approved toxic dust respirator. Be sure you are familiar with the right procedures for using and maintaining the respirator. Although not as efficient, a simple mask could provide some help if a respirator is not available.

**Objective 2:** Identify the signs and symptoms of Farmer's lung.

**Anticipated Problem:** What is Farmer's Lung?

Farmer's lung is a disease that is caused by breathing mold spores from moldy hay, straw, or grain. This causes an allergic inflammation of the lungs, which in early stages of the disease cause symptoms like the common cold. Inflammation is the body's way of responding to tissue irritation. Inflammation causes



pain, redness, swelling and sometimes loss of function. Mold produces toxins which irritate the respiratory tract. Although the cold-like symptoms of farmer's lung are often mild, if ignored, it can cause permanent lung damage because it will cause the lung tissue to scar, which is known as pulmonary fibrosis. This scarring is because of the repeated inflammation that causes cell damage. This repeated injury is chronic farmer's lung; chronic meaning long lasting or permanent disease.

Mold spores attach to dust particles in the air when farmers move or work with hay, grain, or silage materials where mold has grown. As a result, farmers breathe both dust particles and mold spores. The body has natural defense mechanisms (such as coughing, sneezing, and mucous lined nasal passages) that help prevent dust and other particles from entering the lungs. However, mold spores can often get through these defenses because of their small size and overwhelming numbers.

Mold spores build up, and settle in the lower lungs, this is where most gas exchange takes place. Toxins produced by the mold spores are then able to travel through the bloodstream with the oxygen. The body reacts to the toxins with an allergic inflammation which causes permanent scarring of the lung tissue. This in turn affects the lungs' ability to transfer oxygen into the bloodstream. Each exposure to mold spores increases the damage.

Symptoms of farmer's lung include:

- Fever
- Chills
- A runny nose
- A nonproductive cough
- Blood-streaked sputum
- Labored or difficult breathing, with a feeling of tightness in the chest
- Shortness of breath
- Crackling breathing (also known as rales)
- Muscle pain
- Weight loss
- Weakness
- Depression

Chronic farmer's lung results from repeated exposure to moldy dust. The amount of dust can be so small that the farmer is hardly aware of them.

Farmer's lung cannot be cured. The symptoms can be treated with bed rest and oxygen therapy. Medication can be used to control symptoms in chronic cases. However, this can be dangerous, because damage to the lungs may continue without the farmer knowing.

The only proven treatment for chronic farmer's lung is for a person to avoid contact with moldy crop materials. Just as there is no way of curing the disease once it has developed, lung damage cannot be repaired. Those with farmer's lung may be forced to give up farming and also may suffer from permanent disability or even death.



**Objective 3:** Explain the difference between Toxic Organic Dust Syndrome (TODS) and farmer's lung

**Anticipated Problem:** What is TODS?

Toxic Organic Dust Syndrome (TODS) is caused by exposure to very large amounts of dust. TODS symptoms include cold-like symptoms, which are the same as acute farmer's lung attacks. However, TODS is not an allergic reaction. While anyone can get TODS, and can become very sick, most people recover completely. Having TODS does not damage your lungs, and does not increase the risk of getting TODS again.

Farmer's lung is an allergic inflammatory response, while TODS is a non-allergic inflammatory response of the alveoli. This is demonstrated by the fact that TODS is quite common and symptoms often occur at the same time in many people who were exposed, while farmer's lung happens exclusively in people who are sensitive to the exposure. Only farmer's lung can become chronic, with some cases becoming worse over time causing irreversible damage to lungs which can lead to permanent disability or death. It can be difficult to know if a person has acute farmer's lung or TODS because of this sometimes individuals develop permanent lung damage due to misdiagnosis.

**Objective 4:** Define Work-related asthma.

**Anticipated Problem:** What is asthma?

Asthma is a chronic lung disease that can make it hard to breath. Chronic means lasting long term. People with asthma have airways that are hyperresponsive, meaning that their airways react to asthma triggers such as cold, cigarette smoke and exercise faster and more intensely than people whose airways are normal.

What happens during an asthma episode?

- The lining of the airways become inflamed and swell.
- More mucus is produced, making the opening in the airways smaller.
- The muscles around the airways tighten, also making the opening in the airways smaller.

Triggers of Asthma

A trigger is any object, act, or event that causes the airways to become inflamed or causes asthma symptoms. The muscles in the airways react to triggers and causes them to contract, tighten and narrow, making it harder to breath.

Common triggers include:

- Exercise
- Virus Infection (cold, bronchitis, pneumonia)
- Cigarette smoke
- Outdoor or indoor air pollution
- Allergens, such as cats, dogs, dust mites, cockroaches, grass, mold, and pollen
- Cold air
- Some medicines and chemicals
- Occupational exposures, such as chemicals or dusts

- Sinusitis or other respiratory tract infections

### Signs and Symptoms

Asthma signs and symptoms differ from person to person and depend on the trigger the individual was exposed to.

Common signs and symptoms include:

- Wheezing
- Coughing
- Feeling tired
- Shortness of Breath
- Tightness or heaviness of chest
- Difficulty breathing with exercise
- Night cough

A person may have some or all of these symptoms at any time.

Work-related asthma is asthma that is caused or made worse by something at work.

Agriculture is considered a high-risk industry for work-related asthma. Farmers are exposed to many occupational asthma triggers but there are things that can be done to reduce risk.

There are two types of work-related asthma:

- Work aggravated asthma: Asthma that is made worse by exposures at work in someone who already has asthma.
- Occupational asthma: New asthma that develops after exposures at work in someone who didn't have asthma before.

Work-related asthma symptoms usually occur after you are exposed to the trigger, and often improve or go away when you leave work. Some people may not have symptoms until 12 or more hours after being exposed to the trigger. Symptoms usually get worse toward the end of the work week and may go away on weekends or vacations. However, the effects of work-related asthma are often caused by exposures which over time can damage the lung by scarring because of inflammation. This scar damage is not reversible which can lead to symptoms that are persistent and permanent.

### Answer to Sample Test:

1. Harvested crops such as hay and grains should be dry when stored, sprinkling one liter of water onto the cut side of the bale immediately before opening or chopping it, indoor humidity should be maintained below 80% to reduce air borne organisms, rotating crops will help to decrease fungal growth, using pellet feed rather than dusty chopped feed, or by substituting silage for hay, when cleaning use a wet process, use a fork to spread out open bales, moisten the top layer of silage before opening it, in the fields, lower the speed of equipment to reduce the release of

fine particles, organize equipment and work practices so that any prevailing wind can carry the dust away from your face, provide as much ventilation as possible when working in dusty areas.

2. Farmer's Lung
3. Breathing mold spores from moldy hay, straw, or grain; which causes an allergic inflammation of the lungs.
4. The Alveoli
5. Coughing, sneezing, and mucous lined nasal passages
6. Fever, chills, a runny nose, a nonproductive cough, blood-streaked sputum, labored or difficult breathing, with a feeling of tightness in the chest, shortness of breath, crackling breathing (also known as rales), muscle pain, weight loss, weakness, depression
7. TODS
8. Farmer's lung is an allergic inflammatory response, while TODS is a non-allergic inflammatory response of the alveoli. This is demonstrated by the fact that TODS is quite common and symptoms often occur at the same time in many people who were exposed, while farmer's lung happens in people who are sensitive to the exposure. Only farmer's lung can become chronic, with some cases becoming worse over time causing irreversible damage to lungs which can lead to permanent disability or death.
9. Work aggravated and occupational asthma

**Sample Test:**

1. List 6 ways you can prevent dust and mold from creating respiratory damage.
2. Which causes more respiratory damage TODS or Farmer's lung?
3. What causes Farmer's Lung?
4. What part of the respiratory tract is most affected by mold and dust?
5. The body has natural protective mechanisms against dust inhalation, name two of them.
6. Name 5 symptoms of Farmer's Lung
7. If all class members come down with cold symptoms after an agricultural activity what disease, TODS or Farmer's Lung, is the most likely cause?
8. List three major differences between Farmer's Lung and TODS.
9. What are the two types of work related asthma?

*Let us know how it went. We are always trying to improve this lesson plan. Please send any comments or suggestions to the Utah Asthma Program ([asthma@utah.gov](mailto:asthma@utah.gov)).*



## Lab activity:

### Air Sampling

This activity will give you a chance to investigate some of the material in the air you breathe every day.

#### Materials

- a glass jar with a wide opening (such as a mayonnaise or jelly jar)
- petroleum jelly
- cotton swabs
- masking tape
- permanent markers
- hand-held lenses or microscopes
- transparent tape
- camera (optional)

#### Procedure

1. Using cotton swabs, spread petroleum jelly on the entire inside surface of the jar. You don't need a lot—just enough to make the surface of the glass sticky. This is your testing device. Particles in the air will stick to the petroleum jelly and you can observe them later. Using a permanent marker on strips of masking tape, write your name and the date and put the label on the outside of your jar.
2. With your partner, choose a location inside the school or outdoors to collect your sample. You will need to leave your jar in the same spot for a week, so select a spot that will not be disturbed.
3. Place your jar in the selected spot. If you are using a camera to document your experiment, take a picture of the starting phase. You may want to leave a note explaining the experiment and asking that the jar not be disturbed.
4. During the next week, visit your jar several times. Keep track of the weather and wind patterns that occur each day. Take notes, make sketches, or take photographs to show the changes to the inside of the jar.
5. After a week, bring your jar back to class. Use a hand-held lens to inspect the particles stuck to the glass. If you have microscopes available, you can collect samples from your jar by pressing transparent tape against the particles, then placing the tape on a microscope slide. Try to identify the particles.
6. Compare your findings with the findings of other people in your class. What are the differences between the indoor and outdoor air samples? Which location had the most airborne particles? Which had the least? How could these particles affect respiratory health? What are possible ways to protect respiratory health in the various areas of sample collection?

#### Tips for the lab activity

- This activity can be modified by only have 1-2 jars per class.
- Ask students to bring a jar from home.
- Petroleum jelly can be purchased at most grocery and super stores (Walmart, Target, etc.)