Utah Asthma Task Force
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Agriculture Mechanics Course

Under Agricultural Science Core **Standard 3-** Students will identify hazards in Agricultural Mechanics

New **Objective:** Students will recognize the respiratory health risks when working in Agricultural Mechanics

Learning goal: Students will know when and how to wear protective respiratory equipment.

Student Learning Objectives:
1. Explain the effects of air contaminants the respiratory system.
2. Discuss when to wear a respirator and the correct type.
3. Demonstrate how to do a Fit test on a respirator.

List of resources:
Occupational Safety and Health Administration (OSHA)
National Ag Safety Database

List of equipment, tools, supplies and facilities:
Writing Surface
Overhead Projector
Copies of student lab sheet
Materials for lab

Terms:
Pulmonary system
Pulmonary edema
Emphysema
Cilia

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:
Clip demonstrating a fit test (For example from the Discovery Channel's Dirty Jobs or on YouTube such as http://www.youtube.com/watch?v=arbQbGuvwaM)

Summary of Content and Teaching Strategies:

Objective 1: Explain the effects of fumes on the respiratory system.

Anticipated Problem: Need a working knowledge of the respiratory system.

The respiratory system consists of your lungs, airways, diaphragm, windpipe, throat, mouth, and nose. Oxygen is enters the body through the mouth and nose, is absorbed into the lungs, and then transported through the body in the blood. The respiratory system is also known as the pulmonary system. Pulmonary means having to do with the lungs. When working in agriculture mechanics there are many factors that can prevent the respiratory system from working right, these include fumes from gases and chemicals.

Gases and chemical can cause irritation of the cells lining the airways within the lungs. One of the body's basic responses to protect against this is to produce mucus. This mucus can make the airway opening smaller making it more difficult to breathe.

In a healthy person, there are cells lining the lungs and upper respiratory tract that have small hair-like projections called cilia. These vibrate to move dust and debris out of the lungs. Certain chemicals can kill or damage these cells so that they are not able to effectively clean the lungs.

Signs and symptoms of exposure

1. Acute exposure: Acute exposure to air contaminants such as welding fumes can result in eye, nose, and throat irritation, fever, chills, headache, nausea, shortness of breath, muscle pain, and a metallic taste in the mouth.

2. Chronic exposure: Chronic exposure can result in respiratory effects including coughing, wheezing, and decreased pulmonary function.

Common elements that cause respiratory problems:
(OSHA - http://www.osha.gov/doc/outreachtraining/htmifiles/weldhith.html)

CADMIUM

Cadmium is used frequently as a rust-preventive coating on steel and also as an alloying element. Acute exposures to high concentrations of cadmium fumes can produce severe lung irritation, pulmonary edema (fluid in the lungs), and in some case cancer and death. Long-term exposure to low levels of cadmium in air can result in emphysema (a disease affecting the ability of the lung to absorb oxygen).

BERYLLIUM

Beryllium is sometimes used as an alloying element with copper and other base metals. Acute exposure to high concentrations of beryllium can result in chemical pneumonia. Long-term exposure can result in shortness of breath, a chronic cough and cancer.

FLUORIDES

Fluoride compounds are found in the coatings of several types of fluxes used in welding. Exposure to these fluxes may irritate the eyes, nose, and throat. Repeated exposure to high concentrations of fluorides in air over a long period may cause pulmonary edema (fluid in the lungs).

PHOSGENE

Phosgene is formed by decomposition of chlorinated hydrocarbon solvents by ultraviolet radiation. It reacts with moisture in the lungs to produce hydrochloric acid, which in turn destroys lung tissue. For

this reason, any use of chlorinated solvents should be well away from welding operations or any operation in which ultraviolet radiation or intense heat is generated.

CARBON MONOXIDE

Carbon monoxide is a gas usually formed by the incomplete combustion of various fuels. Welding and cutting may produce significant amounts of carbon monoxide. In addition, welding operations that use carbon dioxide as the inert gas shield may produce hazardous concentrations of carbon monoxide in poorly ventilated areas. This is caused by a "breakdown" of shielding gas. Carbon monoxide is odorless, colorless and tasteless and cannot be readily detected by the senses. Common symptoms of overexposure include pounding of the heart, a dull headache, flashes before the eyes, dizziness, ringing in the ears, and nausea.

OZONE

Ozone is produced by ultraviolet light from the welding arc. Ozone is a highly active form of oxygen and can cause great irritation to all mucous membranes. Symptoms of ozone exposure include headache, chest pain, and dryness of the upper respiratory tract. Excessive exposure can cause fluid in the lungs (pulmonary edema).

NITROGEN OXIDES

The ultraviolet light of the arc can produce nitrogen oxides, from the nitrogen and oxygen in the air. This gas is irritating to the eyes, nose and throat but dangerous concentrations can be inhaled without any immediate discomfort. High concentrations can cause shortness of breath, chest pain, and fluid in the lungs (pulmonary edema).Nitrogen oxide is also a known asthma trigger.

Objective 2: Discuss when to wear a respirator and the correct type.

Anticipated Problem: Who needs respiratory protection?

According to the National Ag Safety Database those who work in the following need respiratory protection:

- work in dusty fields and buildings
- handle moldy hay
- work in silos
- feed or work with feedstuffs
- work in corn silage
- uncap silos
- clean grain bins
- work in areas where bird droppings or dust from animal hair, feathers, or fur are present
- work with fish meal
- apply agricultural chemicals ((e.g. fertilizers, pesticides, fumigants)
- work with toxic paints or solvents
- work in areas where dust containing old paint, rust and wood particles

Respiratory protection equipment is placed in one of two categories: 1) air purifying respirators (APR); or, 2) supplied air respirators (SAR).
Air purifying devices remove contaminants from the air and are used only where there is enough of an oxygen supply. These devices include mechanical filter, chemical cartridge, and canister gas mask respirators.
Supplied air respirators are used when there is not enough oxygen in the area you are working. These respirators include supplied-air respirators and self-contained breathing apparatus (SCBA).
In case the respirator cannot or will not be used a simple mask should be used. The respirator is more efficient at removing the particles but a mask will still help.

If you are unsure which type of protective equipment is best for your work check the Materials Safety Data Sheets (MSDS) for recommendations. MSDS is intended to provide workers and emergency personnel with information on how to handle or work with that substance in a safe manner, and includes information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures.
Most types of protective respiratory equipment can be found at safety supply stores. Farm supply stores and agricultural chemical suppliers are also good places to find protective respiratory equipment.

Objective 3: Demonstrate how to do a Fit test on a respirator.

Anticipated Problem: What is a fit test?
A fit test is a test of how well a respirator fits on an individual.
OSHA (Occupational Safety and Health Administration) requires employers to properly fit test their respirators to those who will use them. A fit test assessment can take up to 30 minutes.

From the OSHA standard: ***Fit test*** means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.

Qualitative fit test (QLFT) means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

Quantitative fit test (QNFT) means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

There are different methods to fit test a respirator but for the purposed of this class we will review one method of the qualitative fit test.

Before fit testing any facial hair that is between the face and face piece seal should be removed before using and/or testing a respirator. Any type of apparel (such as safety goggles) which interferes with a good seal should also be fixed or removed to make sure there is a good fit.

First test for comfort, the mask should be worn for at least five minutes to make sure it is comfortable. Make sure there is enough time to review the following points to ensure the masks is comfortable:

- Position of the mask on the nose
- Room for eye protection
- Room to talk
- Position of mask on face and cheeks

To test if the mask fits one test agent used saccharin: A white, crystalline powder used as a calorie-free sweetener. It tastes about 500 times sweeter than sugar. This sugar solution substitutes for air contaminants and helps determine if there are any air leaks. First a saccharin taste screening is performed. This is done without the individual wearing a respirator. The solution is sprayed to determine if a person can taste saccharin so they can remember the taste to use as a reference during the test.

A series of test exercises are completed while trying to determine if any contaminated air leaks through the respirator. This is done by having the test subject try to smell or taste a saccharin solution that is sprayed around them when they are wearing their respirator.

Saccharin solution aerosol fit test procedure.

The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

The test subject should put on the respirator. Throughout the test, the test subject should breathe through his/her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a sweet taste

After spraying the saccharin solution, the test subject should be instructed to perform the following exercises: Before each exercise the saccharin solution should be sprayed.

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each side for a moment so the subject can inhale at each side.

(4) Moving head up and down. Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

(6) Grimace. The test subject shall grimace by smiling or frowning.

(7) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments units that do not permit bending over at the waist.

(8) Repeat normal breathing. Same as exercise (1).

The test subject shall indicate to the test conductor if at any time they taste the saccharin. If the test subject does not report tasting the saccharin, the test is passed.

If the taste of saccharin is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall then be tried and the entire test procedure is repeated.

Fit testing should not be confused with a respirator fit check. A fit check, or "user seal check" as it's referred to by OSHA should be performed each time a tight-fitting respirator is donned to ensure there's an adequate seal.

1. Positive fit check – exhale while covering the exhalation valve with the palm of your hand – if you feel air against the skin of your face, there is a leak in the seal.
2. Negative fit check – cover the cartridge(s) with your hands and inhale –if the mask is drawn tightly to your face, there is no leakage.

Make sure the equipment properly fits you. An air leak defeats the effectiveness of even the best respirator for the situation. Testing the equipment will assure a proper fit and protection.

Answers to Sample Test:

1. A fit check, or "user seal check" as it's referred to by OSHA should be performed each time a tight-fitting respirator is put on to ensure there's an adequate seal. Whereas fit testing is done

when using a new respiratory and is the process by which you determine if the respirator fits you face and no air contaminants leak.

2. OSHA
3. You may not be able to taste or smell the saccharin.
4. Fluid in the lungs
5. Work in dusty fields and buildings, work handling moldy hay, work in silos, feed or work with feedstuffs, work in corn silage, uncap silos, clean grain bins, work in areas where bird droppings or dust from animal hair, feathers, or fur are present, work with fish meal, apply agricultural chemicals ((e.g. fertilizers, pesticides, fumigants), work with toxic paints or solvents, work in areas where dust containing old paint, rust and wood particles

Sample Test:

1. What is the difference between a fit test and a respiratory fit check?
2. What agency requires fit tests?
3. Why should you not eat 15 minutes before a fit test?
4. Define pulmonary edema.
5. Name five areas that you need respiratory protection.

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).

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Lab activity:

PPE Hazard Assessment Certification Form

Have the students divide into groups each group choosing a classroom, barn, workshop etc. to assess.
The group will then fill out the following assessment certification form.
The students will determine when PPE is needed and if they usually use the proper protective equipment while in the various settings.
Afterward verify that they have the answers right and that the right PPE is available.
Discuss how to control the hazard in other ways besides PPE.

PPE Hazard Assessment Certification Form

Name of work place: _____ **Assessment conducted by**: _____

Work area(s): _____ **Date of assessment:** _____

EYES

Work activities, such as:	Work-related exposure to:	Can hazard be eliminated without the use of PPE?
☐ abrasive blasting ☐ chopping ☐ cutting ☐ drilling ☐ welding ☐ soldering ☐ torch brazing ☐ working outdoors ☐ computer work ☐ punch press operations ☐ other: ☐ sanding ☐ sawing ☐ grinding ☐ hammering ☐ chipping	☐ airborne dust ☐ dirt ☐ UV ☐ flying particles/objects ☐ blood splashes ☐ hazardous liquid chemicals mists ☐ chemical splashes ☐ molten metal splashes ☐ glare/high intensity lights ☐ laser operations ☐ intense light ☐ hot sparks ☐ other:	Yes ☐ No ☐ If no, use: ☐ Safety glasses ☐ Safety goggles ☐ Dust-tight goggles ☐ Impact goggles ☐ Welding helmet/shield ☐ Chemical goggles ☐ Chemical splash goggles ☐ Laser goggles ☐ Shading/Filter ☐ Welding shield ☐ Other: With: ☐ Side shields ☐ Face shield ☐ Shaded ☐ Prescription

FACE

Work activities, such as:	Work-related exposure to:	Can hazard be eliminated without the use of PPE?
☐ cleaning ☐ cooking ☐ siphoning ☐ painting ☐ dip tank operations ☐ pouring ☐ other: ☐ foundry work ☐ welding ☐ mixing ☐ pouring molten metal ☐ working outdoors	☐ hazardous liquid chemicals ☐ extreme heat ☐ extreme cold ☐ potential irritants: ☐ other:	Yes ☐ No ☐ If no, use: ☐ Face shield ☐ Shading/Filter ☐ Welding shield ☐ Other:

HEAD

Work activities, such as:	Work-related exposure to:	Can hazard be eliminated without the use of PPE?
☐ building maintenance ☐ confined space operations ☐ construction ☐ electrical wiring ☐ walking/working under catwalks ☐ walking/working on catwalks ☐ walking/working under conveyor belts ☐ working with/around conveyor belts ☐ walking/working under crane loads ☐ utility work ☐ other:	☐ beams ☐ pipes ☐ exposed electrical wiring or components ☐ falling objects ☐ fixed object ☐ machine parts ☐ other:	Yes ☐ No ☐ If no, use: ☐ Protective Helmet ☐ Type A (low voltage) ☐ Type B (high voltage) ☐ Type C ☐ Bump cap ☐ Hair net or soft cap ☐ Other:

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HANDS/ARMS

Work activities, such as:

- ☐ baking
- ☐ cooking
- ☐ grinding
- ☐ welding
- ☐ working with glass
- ☐ using computers
- ☐ using knives
- ☐ dental and health care services
- ☐ garbage disposal
- ☐ computer work
- ☐ other:
- ☐ material handling
- ☐ sanding
- ☐ sawing
- ☐ hammering
- ☐ using power tools
- ☐ working outdoors

Work-related exposure to:

- ☐ blood
- ☐ irritating chemicals
- ☐ tools or materials that could scrape, bruise, or cut
- ☐ extreme heat
- ☐ extreme cold
- ☐ animal bites
- ☐ electric shock
- ☐ vibration
- ☐ musculoskeletal disorders
- ☐ sharps injury
- ☐ other:

Can hazard be eliminated without the use of PPE?

Yes ☐ No ☐

If no, use:

- ☐ Gloves
  - ☐ Chemical resistance
  - ☐ Liquid/leak resistance
  - ☐ Temperature resistance
  - ☐ Abrasion/cut resistance
  - ☐ Slip resistance
  - ☐ Latex or nitrile
  - ☐ Anti-vibration
- ☐ Protective sleeves
- ☐ Ergonomic equipment_____
- ☐ Other:

FEET/LEGS

Work activities, such as:

- ☐ building maintenance
- ☐ construction
- ☐ demolition
- ☐ food processing
- ☐ foundry work
- ☐ working outdoors
- ☐ logging
- ☐ plumbing
- ☐ trenching
- ☐ use of highly flammable materials
- ☐ welding
- ☐ other:

Work-related exposure to:

- ☐ explosive atmospheres
- ☐ explosives
- ☐ exposed electrical wiring or components
- ☐ heavy equipment
- ☐ slippery surfaces
- ☐ impact from objects
- ☐ pinch points
- ☐ crushing
- ☐ slippery/wet surface
- ☐ sharps injury
- ☐ blood
- ☐ chemical splash
- ☐ chemical penetration
- ☐ extreme heat/cold
- ☐ fall
- ☐ other:

Can hazard be eliminated without the use of PPE?

Yes ☐ No ☐

If no, use:

- ☐ Safety shoes or boots
  - ☐ Toe protection
  - ☐ Electrical protection
  - ☐ Puncture resistance
  - ☐ Anti-slip soles
  - ☐ Metatarsal protection
  - ☐ Heat/cold protection
  - ☐ Chemical resistance
- ☐ Leggings or chaps
- ☐ Foot-Leg guards
- ☐ Other:

BODY/SKIN		
Work activities such as: ☐ baking or frying ☐ battery charging ☐ dip tank operations ☐ fiberglass installation ☐ sawing ☐ other:	Work-related exposure to: ☐ chemical splashes ☐ extreme heat ☐ extreme cold ☐ sharp or rough edges ☐ irritating chemicals ☐ other:	Can hazard be eliminated without the use of PPE? Yes ☐ No ☐ If no, use: With: ☐ Vest, Jacket ☐ Long sleeves ☐ Coveralls, Body suit ☐ Raingear ☐ Apron ☐ Welding leathers ☐ Abrasion/cut resistance ☐ Other:

BODY/WHOLE		
Work activities such as: ☐ building maintenance ☐ construction ☐ logging ☐ computer work ☐ working outdoors ☐ utility work ☐ other:	Work-related exposure to: ☐ working from heights of 10 feet or more ☐ impact from flying objects ☐ impact from moving vehicles ☐ sharps injury ☐ blood ☐ electrical/static discharge ☐ hot metal ☐ musculoskeletal disorders ☐ sparks ☐ chemicals ☐ extreme heat/cold ☐ elevated walking/working surface ☐ working near water ☐ injury from slip/trip/fall ☐ other:	Can hazard be eliminated without the use of PPE? Yes ☐ No ☐ If no, use: With: ☐ Fall Arrest/Restraint ☐ Hood ☐ Traffic vest ☐ Full sleeves ☐ Static coats/overalls ☐ Flame resistant jacket/pants ☐ Insulated jacket ☐ Cut resistant sleeves/wristlets ☐ hoists/lifts ☐ ergonomic equipment: _____ ☐ Other:

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LUNGS/RESPIRATORY		
Work activities such as: ☐ cleaning ☐ mixing ☐ painting ☐ fiberglass installation ☐ compressed air or gas operations ☐ confined space work ☐ floor installation ☐ ceiling repair ☐ working outdoors ☐ other: ☐ pouring ☐ sawing	Work-related exposure to: ☐ dust or particulate ☐ toxic gas/vapor ☐ chemical irritants (acids) ☐ welding fume ☐ asbestos ☐ pesticides ☐ organic vapors ☐ oxygen deficient environment ☐ paint spray ☐ extreme heat/cold ☐ other:	Can hazard be eliminated without the use of PPE? Yes ☐ No ☐ If no, use: ☐ Dust mask ☐ Disposable particulate respirator ☐ Replaceable filter particulate w/cartridge ☐ PAPR (Air recycle) ☐ PPSA (Air supply) With/Type: ☐ face shield ☐ acid/gas crtdg ☐ organic crtdg ☐ pesticide crtdg ☐ spray paint crtdg ☐ half faced ☐ full faced ☐ hooded
EARS/HEARING		
Work activities such as: ☐ generator ☐ ventilation fans ☐ motors ☐ sanding ☐ pneumatic equipment ☐ punch or brake presses ☐ use of conveyors ☐ other: ☐ grinding ☐ machining ☐ routers ☐ sawing ☐ sparks	Work-related exposure to: ☐ loud noises ☐ loud work environment ☐ noisy machines/tools ☐ punch or brake presses ☐ other:	Can hazard be eliminated without the use of PPE? Yes ☐ No ☐ If no, use: ☐ ear muffs ☐ ear plugs ☐ leather welding hood

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