

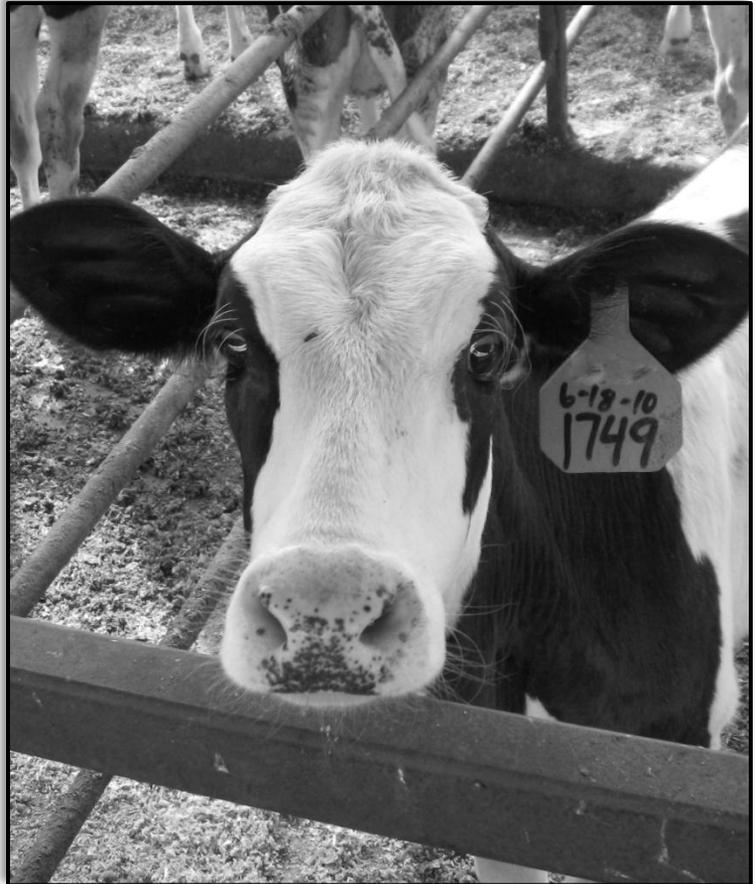
# Food, Water, and Shelter... and AIR!



## Youth Activity Booklet Grades 3-8

Providing the right food, water, and shelter for 4-H livestock is the foundation of every successful 4-H livestock project. But it is time to go **above and beyond** the basics and look at the **AIR** that livestock are breathing everyday!

**Air quality can have a huge impact on the health and productivity of livestock.** In this activity booklet you will learn about what is in the air surrounding us, how it affects the respiratory tract of livestock, and what we can do to provide better AIR for our animals!



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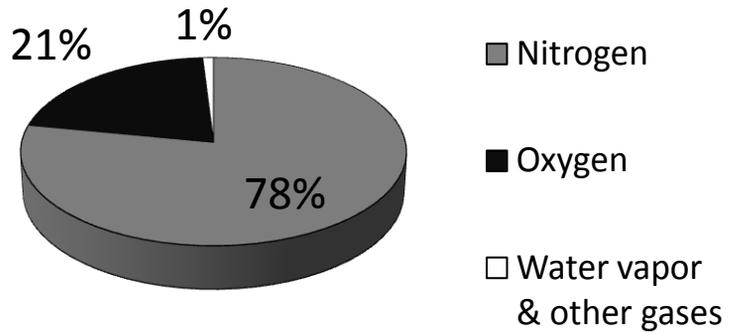


4-H Youth Development Program 

# What is AIR?

When we think of our livestock's housing environment, we tend to just think of the ground or surface they walk on, the fence that keeps them in, and the shelter that we provide for them... but the other important component of livestock housing is the AIR that surrounds livestock! Air contains 21% oxygen. Animals need this much oxygen in the air consistently to survive.

## Composition of Air



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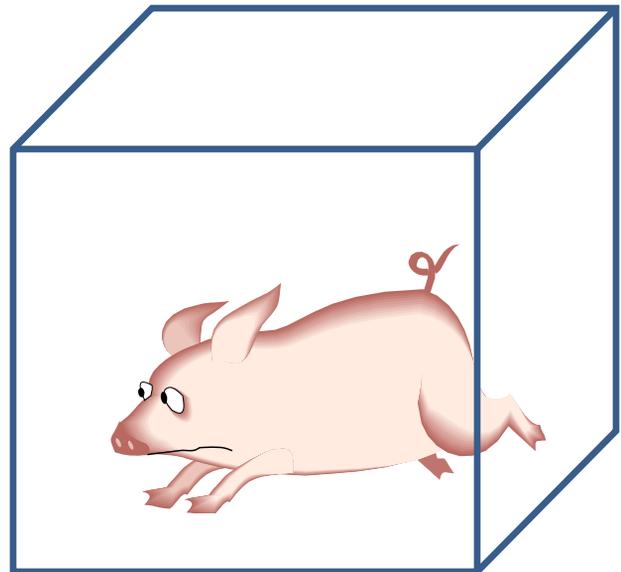
## Stuffy Little Box

For an example, let's say that you put an animal in an airtight glass box for a few minutes (never really do this, of course 😊). *Circle what you think would happen to the percent of oxygen in the air over time:*

*It would increase*

*It would decrease*

*It would stay the same*

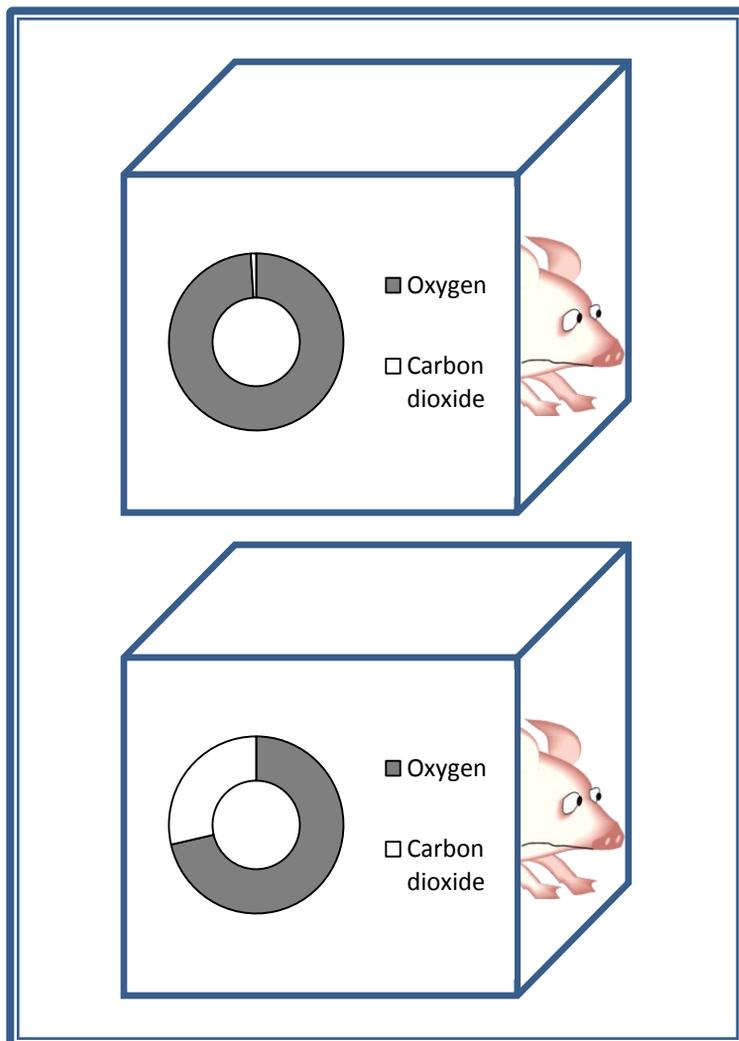


## Air Supply

If you answered “*It will decrease*” on the previous page, great job!

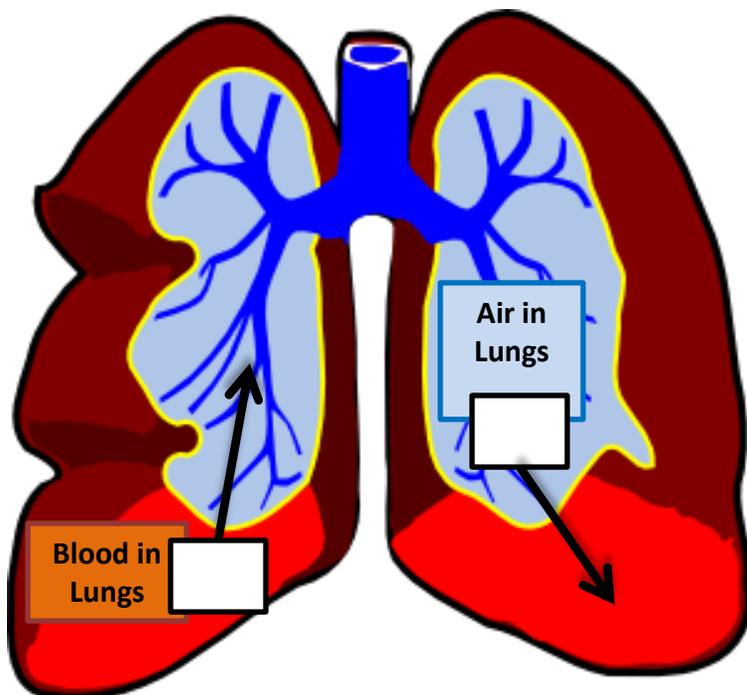
The animal will breathe in 21% oxygen, but in the lungs oxygen in the air is exchanged for carbon dioxide which the animal exhales. This removal of oxygen and addition of carbon dioxide decreases the percentage of oxygen left in the box!

This is an important concept to recognize (even though we don't keep our livestock in airtight glass boxes 😊) because housing that is poorly ventilated will trap exhaled air. This can create a low oxygen and high carbon dioxide air supply for livestock to breathe!



Ventilation, or the replacement of stale air by fresh air, ensures that oxygen levels remain steady and healthy.

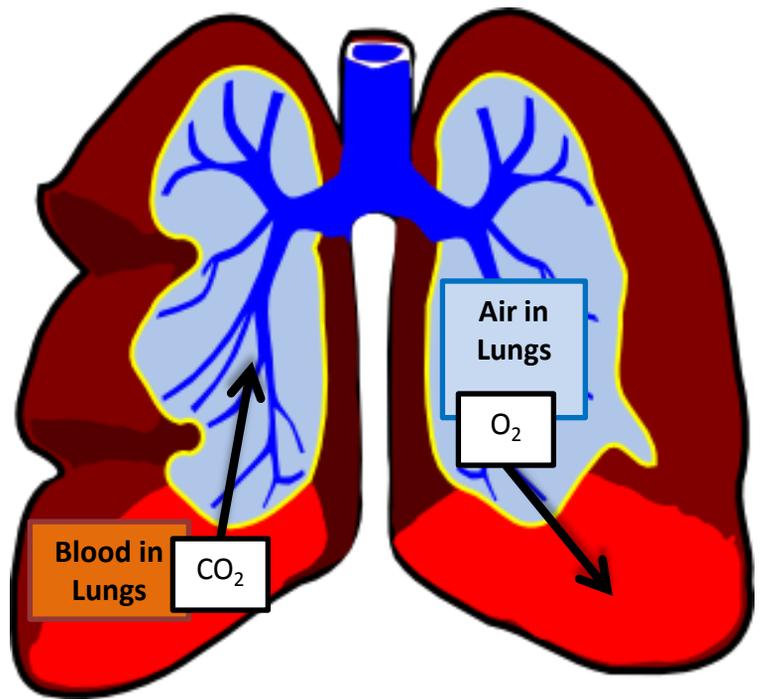
*Fill in the boxes in the diagram to the right to show the movement of oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) in the lungs.*



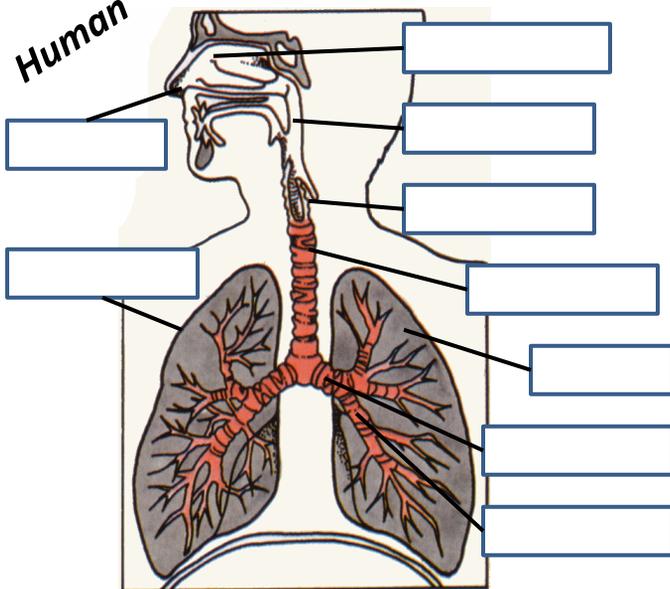
# Air In, Air Out

Is this what your answers looked like? Great!

Providing fresh air not only provides livestock with oxygen, but it also reduces the amount of dust, bacteria, mold spores, and other foreign material that enters the lungs. You can't eliminate these things entirely though even in the cleanest of environments. This is why the respiratory system has its own way of keeping its airways clean!



Human



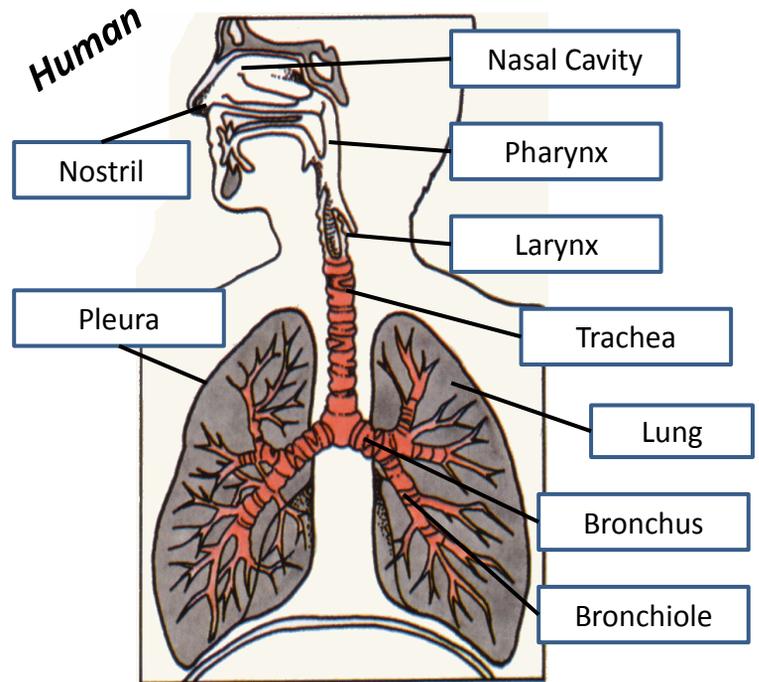
## Anatomy Time

Since most of the respiratory system is deep within the animal, it helps to look at diagrams to learn the parts that have the important job of supplying oxygen and removing carbon dioxide from the animal's body. *Can you label the parts of the respiratory tract on the diagram to the left using the word bank below?*

Word Bank: **Bronchiole** **Bronchus** **Larynx** **Lung** **Nasal Cavity**  
**Nostril** **Pharynx** **Pleura** **Trachea**

## Deep Breaths

How did you do? All of these parts make up the respiratory tract which has many important functions in cleaning the air that reaches deep into the lungs for gas exchange and contact with blood. You and I breath in between 10,000 and 20,000 liters of air a day! Imagine how much more air your livestock take in everyday!



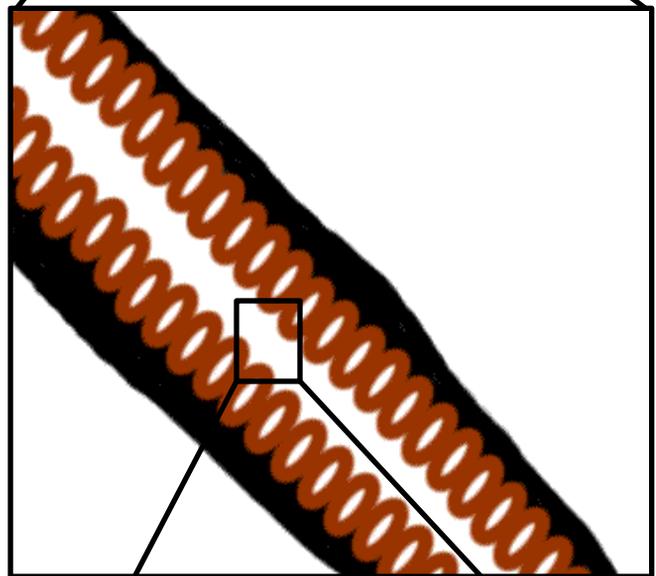
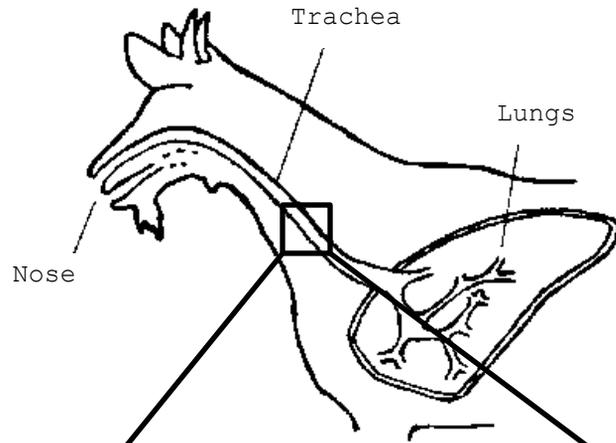
## More Than Just a Wet Nose

Cleaning inhaled air begins at the nostrils, the entry into the nasal passageways. The nose hairs and mucus here trap large particles of dust that harbor bacteria and mold spores. Deep in the nose there are scroll-like passageways that send air in different directions, making it more likely particles will be caught in mucous along the nasal passageways.

# A Sticky Ride

What happens if particles get past the nose and into the trachea? If they are large enough and irritating enough, they will cause coughing, which can expel the particles. We have probably all experienced this feeling when accidentally inhaling a bug or a piece of food.

Smaller inhaled particles have to be stopped so they don't reach the lungs and cause damage or infection. The mucocilliary system protects against this. This system includes a layer of cells lining the trachea all the way down to the bronchioles. The cells have tiny finger-like projections called cilia. These cilia are covered by a layer of mucus. The cilia beat back and forth rapidly to propel mucus back towards the nose and mouth .



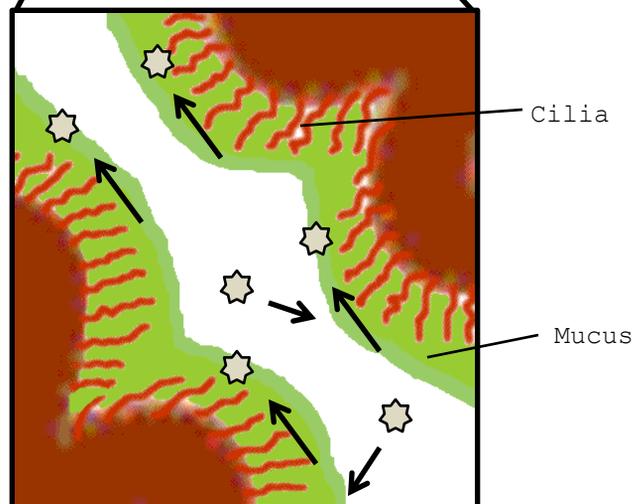
**How fast do you think cilia beat?**

*5-10 times per minute*

*200-500 times per minute*

*700-1,200 times per minute*

(Circle your answer)

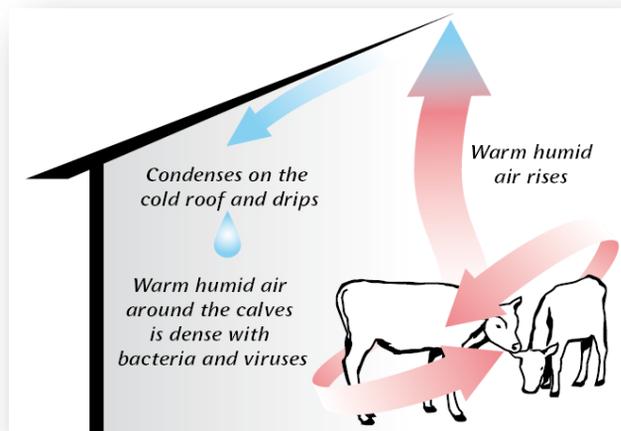


## Healthy Cilia

Those little cilia beat 700-1,200 times per minute to move mucus up the airway!  
That is really moving!

The movement of these little guys is very important for preventing lung damage and infections. Unfortunately, poor ventilation, harmful gases, smoke, and breathing in too many particles and pathogens can damage or overwhelm the mucociliary apparatus.

Poor ventilation in housing environments leads to increased humidity in air that livestock breathe. This is because they are constantly breathing out water vapor from their respiratory tract. If water vapor breathed out by the animals is not removed from the housing structure through proper ventilation, it will build up and condense on the ceiling and walls and eventually drip down on the animals.



Adapted from [www.intervet.co.uk](http://www.intervet.co.uk)

## Too Much Humidity

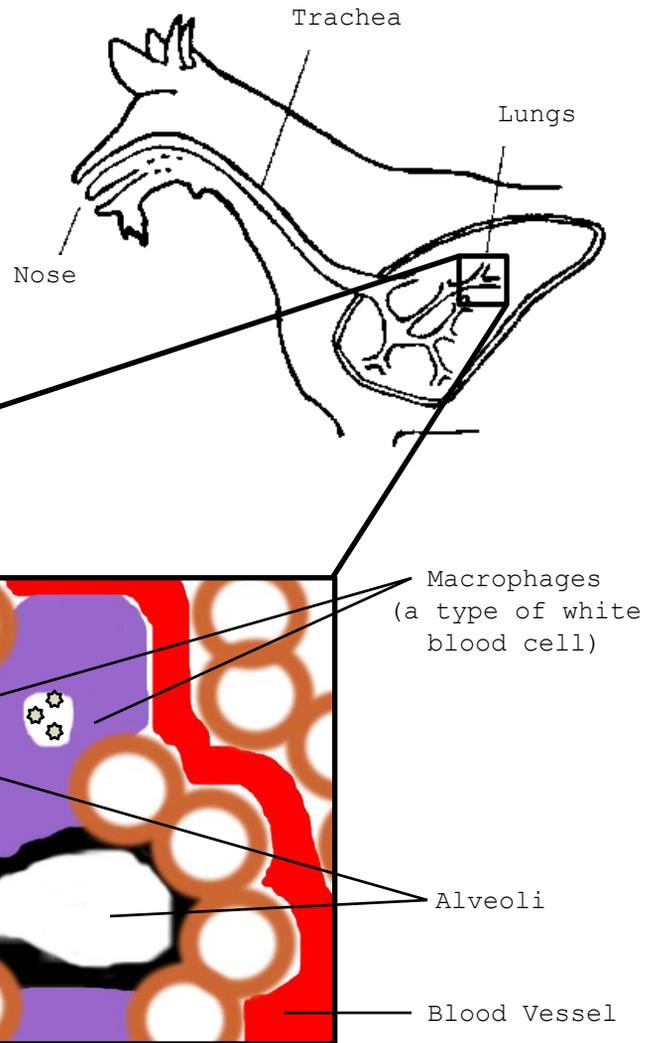


Increased humidity in air surrounding livestock thickens the mucus lining the respiratory tract. The cilia are therefore not able to move as effectively. Particles and bacteria build up and are able to reach deeper into the respiratory tract.

*Water vapor is not visible in the air, but you can see how much water vapor is in every breath you exhale by breathing out with your mouth only an inch away from a mirror or glass surface. Go ahead, try it!*

## Deep Down Dirt

If the mucociliary system is overwhelmed or if very small particles are inhaled that reach beyond the bronchioles, there is a deeper defense mechanism that animals have to combat damage and infection from pathogens. It involves a specific type of white blood cell within the lung called a macrophage, whose job is to eat up foreign material like bacteria, dust, and mold.

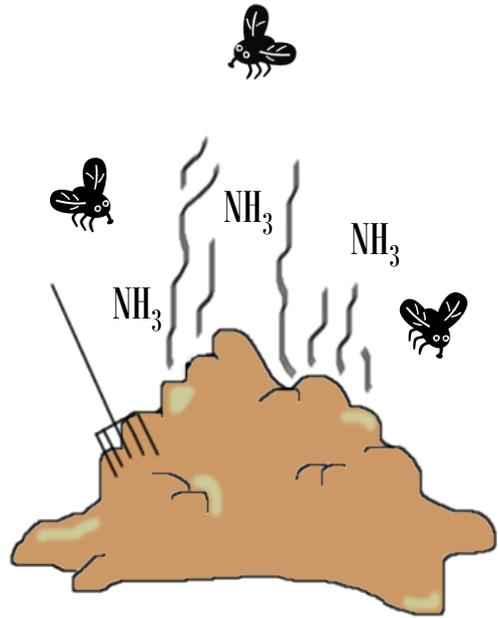


Particles move into the lung

Macrophages engulf particles that reach the deepest part of the lungs, the air sacs called alveoli, and digest them with enzymes. This prevents the particles from causing harm to the animal. Sometimes macrophages take up particles that can't be digested. These cells are then transported back up the trachea towards the mouth by the mucociliary system. In this way the two defense mechanisms really work together. If either of these defense mechanisms is impaired, particles damage the tissue where gas exchange takes place. Bacteria can gain access to the blood stream and be transported throughout the body, leading to illness.

# Phew-wee!

Livestock manure contains nitrogen which is decomposed by bacteria. The bacteria release the nitrogen from the manure into the air in the form of ammonia ( $\text{NH}_3$ ). If manure is allowed to build up within livestock housing ammonia levels increase. High levels of ammonia are unhealthy for both livestock and people who work around them. Prolonged exposure to high levels of ammonia damage and/or paralyze the cilia and inhibit macrophage activity. It also leads to inflammation and sloughing of the cells lining the respiratory tract, making animals more susceptible to respiratory disease. If allowed to accumulate, ammonia also causes skin and eye irritation and displaces oxygen in the bloodstream, which is bad for animal health and wellbeing.



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## Make a Plan

You can reduce the build-up of ammonia in livestock housing by removing manure on a regular basis. This should be done at least once a week and more often during warm weather, when bacteria are growing and rapidly breaking down manure.

***Write down a plan for keeping on top of manure build up:***

*How often will you clean your livestock's living area?* \_\_\_\_\_

*What tools will you use to clean the area?* \_\_\_\_\_

*What do you plan to do with the manure created by your livestock?*

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

# Improving Air Quality

Now that you know why fresh, clean air is important for livestock health and productivity, can you come up with five ways to improve the quality of the air in your livestock housing facility?

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*If you have questions about your animal's health or wellbeing, contact your 4-H leader, extension agent, or veterinarian.*

