

Human Illness and Disease Issues in Livestock and Poultry Production Environments

Selected and additional slides for
a focus on Respiratory Hazards of
Decomposition Gases



Irritant Contact Dermatitis:

characteristic scales, redness and outline



Allergic Contact Dermatitis:

great swelling and redness after exposure to an allergen. Notice difference when compared to Irritant contact dermatitis



Dusts, mostly organic, in hog confinement



Organic dust source:
especially if stored above
ideal moisture level



Organic dust source:
Poultry litter

Dusts and Particulates

- Chronic bronchitis (frequent cough bringing up phlegm) may result.
- The respiratory system's capacity to take in and exhale oxygen may be reduced.

Dusts and Particulates

- There may be an increased susceptibility to respiratory diseases such as colds and pneumonia.
- Episodes of flu-like illness with fever might develop.
- Adverse allergic reactions may result.

Respiratory Hazard Effects

Nationally - 75-100 Deaths each year from asphyxiation.

Approximately 20% of farmers have some form of permanent respiratory impairment.

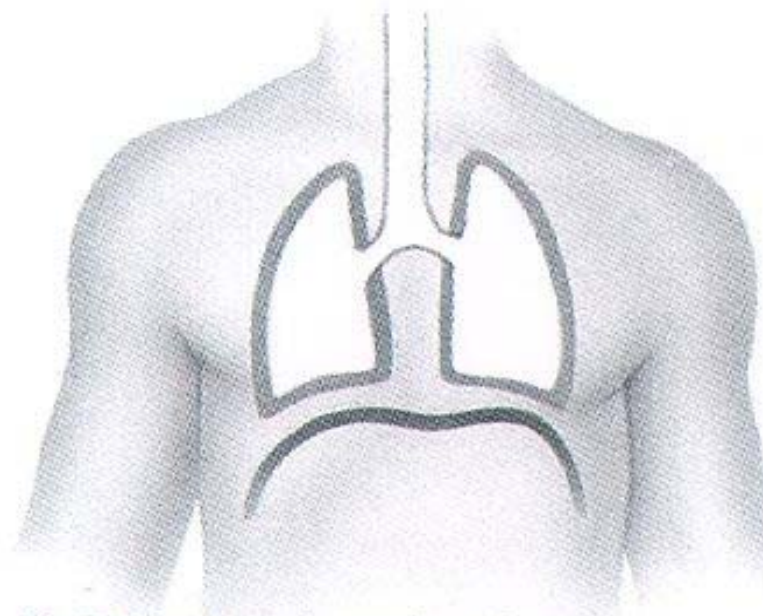
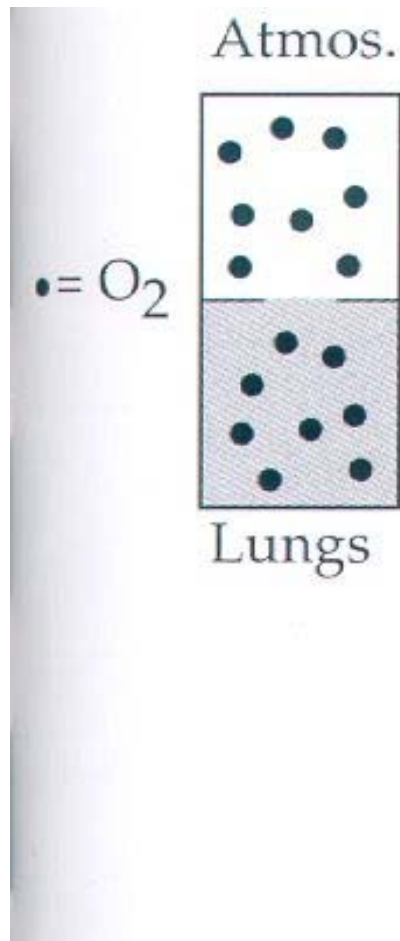
Nearly all farmers suffer at some time from respiratory distress.

Facts

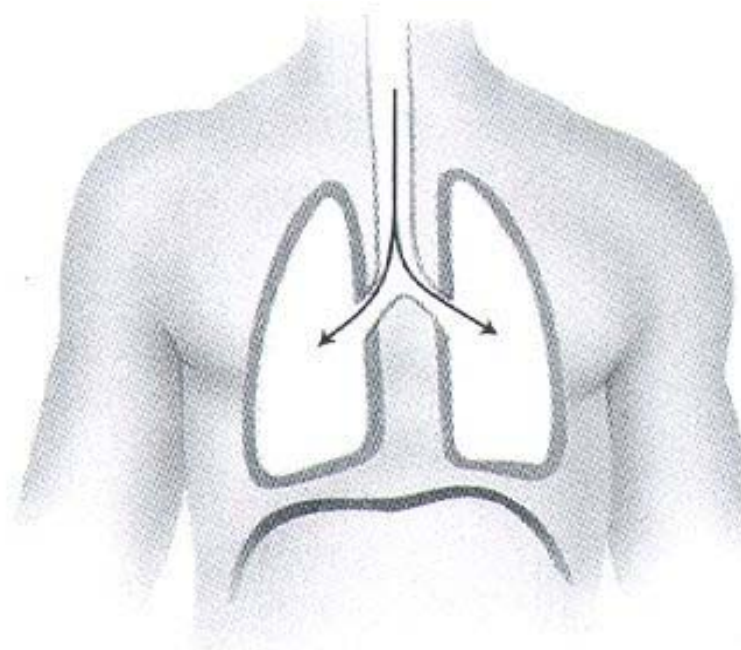
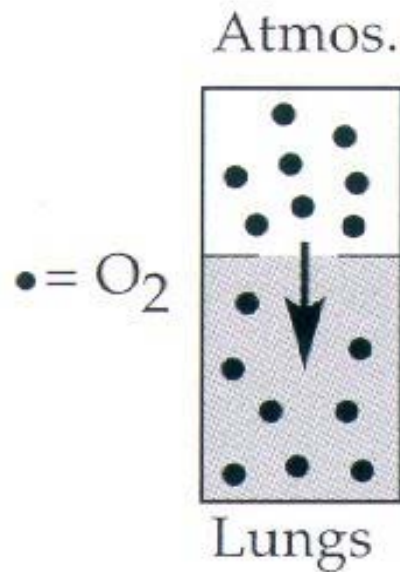
- Relaxed adults breathe 9 to 20 times a minute.
- A person breathes on average 5 to 6 liters of air each minute.
- Oxygen makes up ~ 21% of the air we breathe in and is what body uses to function.

Facts

- Strenuous exercise can increase normal breathing rate by as many as 15 breaths.
- The function of the lungs is to bring oxygen into the body and blood and remove carbon dioxide from the blood and body.

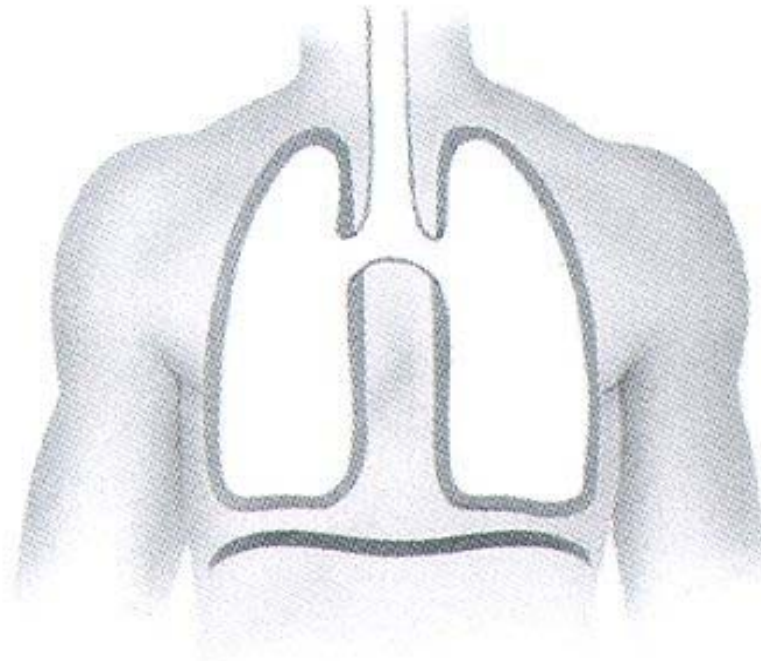
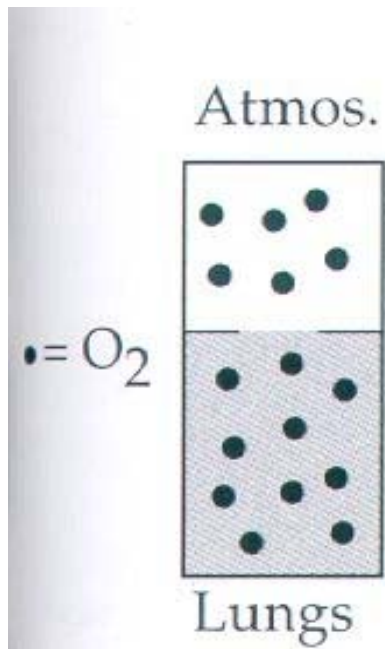


- A) Prior to inspiration:
- diaphragm relaxes
 - pressure in lungs equals atmospheric pressure



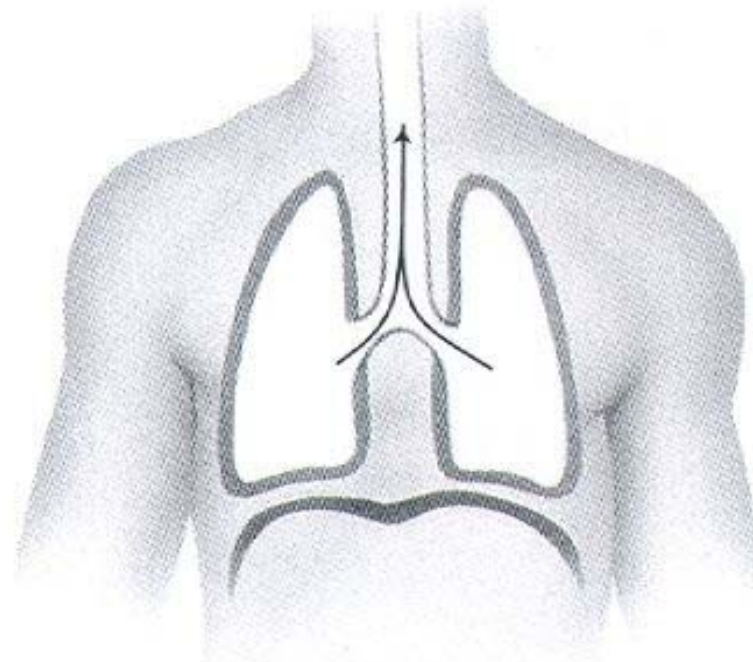
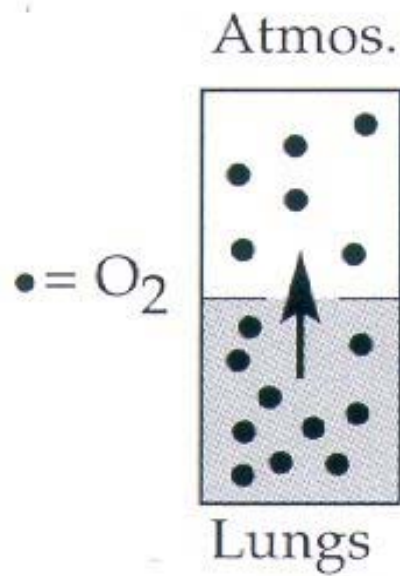
B) During inspiration:

- diaphragm contracts
- rib cage elevates
- pressure in lungs and thorax is lower than atmospheric pressure, so air rushes in



C) Inspiration complete:

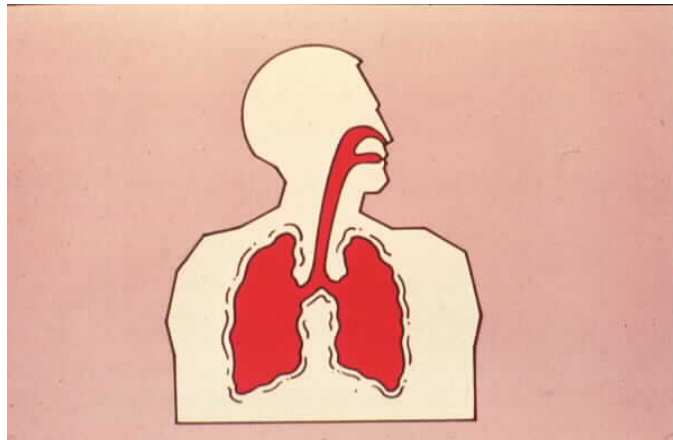
- diaphragm contracted
- rib cage elevated
- pressure in lungs equals atmospheric pressure



D) During expiration:

- diaphragm relaxes
- lungs recoil
- pressure in lungs is higher than atmospheric pressure so air flows out

Laws Related to Respiration	
Law	Application to Respiration
<p>Boyle's Law: The pressure of a gas is inversely proportional to its volume</p>	Muscle contraction during breathing changes lung volume, which affects the air pressure
<p>The Law of Laplace: The smaller the alveolar radius, the greater the surface tension and internal pressure</p>	In the absence of surfactant, smaller alveoli would empty into the larger ones
<p>Dalton's Law: Total pressure is equal to the sum of the partial pressures of each gas in the mixture</p>	Since atmospheric pressure is 760 mm Hg and oxygen makes up 21% of the atmosphere, the partial pressure of oxygen is 21% of 760 or 159 mm Hg
<p>Avogadro's Law: All gases at the same temperature and pressure contain the same number of molecules in a given volume</p>	Water vapor in the lungs contributes a partial pressure to total pressure, reducing the partial pressure of oxygen to 105 mm Hg
<p>Henry's Law: The amount of gas dissolved in a fluid depends on solubility of the gas in the fluid, temperature of the fluid, and partial pressure of the gas</p>	The amount of oxygen dissolved in blood, which has a constant temperature, is directly proportional to the partial pressure of oxygen in the inhaled air



Hypoxia

- Decrease in O₂ content of environmental air
- “Normal” Air – N₂ (78%), O₂ (21%), Argon (.93%), ~28.5 aw
- Any space that O₂ falls under 19.5% is considered **Immediately Dangerous to Life and Health (IDLH)**.

Hypoxia

Percent O ₂ in Air	Signs and Symptoms
21%	None, normal condition
17%	Increased respiratory rate/effort, impaired muscular coordination
12%	Headache, dizziness, fatigue
9%	Unconsciousness
6%	Respiratory/cardiac failure, death in minutes

Types of Farm-Related Respiratory Hazards



Decomposition Gases

- manure gas
- silo gas

Chemicals

- pesticides
- fertilizers
- fuels

Organic/Toxic Dusts

- molds
- grain or feed
- hair, feathers
- dried urine or feces



⚠ DANGER

Dangerous gases may be present in area.
Ventilate and monitor gases before entering any confined space.
No flames or sparks.
Gases can cause loss of consciousness and death and can be explosive.

Consult your employer's Material Safety Data Sheet for further information.

IMPORTANT

Do not leave ladders or other climbing equipment in the area. If using electrical equipment in the area, make sure all tools are in good repair and cords are properly grounded. Agitation of contents increases all hazards. Use special caution to avoid exposure to inhaling gases during and shortly after agitation. If exposure results in loss of consciousness, remove injured party from area. Call physician at once and request orally administrable oxygen. If breathing has stopped, administer mouth to mouth resuscitation until breathing resumes.

⚠ WARNING

Do not cut holes in or make attachments to any part of this tank without prior approval of a qualified structural engineer.
Failure to heed this warning may result in structural failure, collapse, personal injury or death.



- Methane – CH₄, 16
- Odorless, colorless, flammable
- Asphyxiant in high concentrations
- Main component of Natural Gas, contained in other hydrocarbons
- Produced in ANAEROBIC breakdown of certain organic product

Effects of methane exposure on humans and swine.

Exposure level	Effects or symptom
50,000 to 150,000 ppm	Potentially explosive
500,000 ppm	Asphyxiation

- Ammonia – NH_3 , 17
- Colorless, toxic, corrosive, reactive
- Pungent odor (bleach), irritates eyes and nose
- Asphyxiant in high concentrations
- Used in fertilizers, plastics, explosive
- Contained in urine of common domesticated animals along with other nitrogenous wastes

. Effects of ammonia gas exposure on humans and swine.

Exposure level	Effects or symptom
On humans	
6 to 20 ppm and above	Eye irritant, respiratory problems
100 ppm for 1 hr.	Irritation to mucous surfaces
400 ppm for 1 hr.	Irritation to eyes, nose, and throat
700 ppm	Immediate irritation to eyes, nose, and throat
5,000 ppm	Respiratory spasms, rapid suffocation
10,000 ppm and above	Death
On swine	
50 ppm	Reductions in performance and health. Long-term exposure increases the possibility of pneumonia and other respiratory diseases.
100 ppm	Sneezing, salivation, and loss of appetite thereby reducing animal performance.
300 ppm and above	Immediate irritation of nose and mouth. Prolonged exposure causes extremely shallow and irregular breathing followed by convulsions.

- Carbon Monoxide – CO, 28
- Odorless, colorless
- Major component of incomplete carbon combustion – power washers
- Asphyxiant in high concentrations
- oxidation (aerobic) of organic materials

Effects of carbon monoxide exposure on humans and swine.

Exposure level	Effects or symptom
On humans	
50 ppm for 8 hr.	Fatigue, headaches
500 ppm for 3 hr.	Chronic headaches, nausea and impaired mental ability
1,000 ppm for 1 hr.	Convulsions; coma after prolonged exposure
4,000 ppm and over	Death
On swine	
200-250 ppm	Baby pigs are less vigorous
150 ppm and over	Causes abortions in late term sows, and an increased incidence of stillborn pigs. Reduces growth rate of young pigs.



- Carbon Dioxide – CO₂, 44
- Product of combustion of fossil fuels
- Asphyxiant usually due to dispersing air
- Most common gas in CAFO, waste product of mammalian respiration
- oxidation (aerobic) of organic materials

Effects of excess carbon dioxide exposure on humans and swine.

Exposure level	Effects or symptom
On humans	
60,000 ppm for 30 minutes	Heavy tereathing, drowsiness, and headaches
100,000 ppm (10%) and above	Narcotic effect, dizziness, unconsciousness
250,000 ppm (25%) and above	Death
On swine	
40,000 ppm	Increased rate of breatzmg
90,000 ppm	Discomfort
200,000 ppm (20%)	Cannot be tolerated by market hogs for more than one hour

- Hydrogen Sulfide – H₂S, 34
- Colorless, flammable
- Rotten egg smell initially ~ 50ppm
 - Higher concentrations, >500ppm overwhelm olfactory so cannot smell
 - At this level will paralyze involuntary muscles
- Naturally occurs in crude petroleum, natural gas, hot springs
- Naturally occurs in ANAEROBIC breakdown of sulfur containing compounds, released when agitated (stirred, pumped)

Effects of hydrogen sulfide exposure on humans and swine.

Exposure level	Effects or symptom
On humans	
10 ppm	Eye irritation
20 ppm for more than 20 min.	Irritation to the eyes, nose, and throat
50 to 100 ppm	Vomiting, nausea, diarrhea
200 ppm for 1 hr.	Dizziness, nervous system depression, increased susceptibility to pneumonia
500 ppm for 30 min.	Nausea, excitement, unconsciousness
600 ppm and above	Rapid death
On swine	
20 ppm, exposed continually	Fear of light, loss of appetite, nervousness
200 ppm	Possible pulmonary edema (water in the lungs) with breathing difficulties and possible loss of consciousness and death

Decomposition Gases

- High concentrations can be found in areas with conducive conditions and materials AND with low air flow to disperse accumulation
- i.e., certain building locations, during power ventilation outages, etc



Decomposition Gases

- H₂S is especially dangerous in that the same activity, such as agitating pit or manually removing a pit plug, may be done multiple times without adverse concentrations prior to an incident
- Many factors may play role in H₂S release upon agitation: pit level, temp, humidity, liquid ph, feed type, higher levels of naturally occurring in soil

Decomposition Gases

- Not typically a problem with open air structures such as lagoons or slurrystore as gases diffuse
 - Though potential exposure from hose ruptures in dragline or valve leaks







Decomposition Gases

- More potential problem with open outside pumping pits



Decomposition Gases

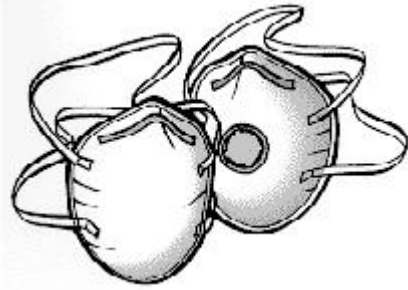
- Most potential
 - pits beneath buildings,
 - Indoor housing collection pits,
 - small access openings on outside pumping pits,
 - manual plug removal at bottom of pit
 - Tank opening when using pump stand











Particulate (Dust/Mist)
Respirator, two-strap



Cartridge respirators: half-mask
and full-mask (completely covers
the face). Different cartridges
available for specific exposures



Air supplying respirators:
Self-contained breathing
apparatus (above) and
line-supplied air respirator
(pump placed in area for
fresh (non-contaminated)
air.

Length of Survival of Pathogens found in Animal Feces

Material	Temp	Duration of Survival					
		Giardia	Crypto-sporidium	Salmonella	Campylo-bacter	Yersinia enterocolitica	E. coli O157:H7
Reference		21-23	24-25	26-28	29-31	30,37	32-36
Water	frozen	< 1 day	> 1 year	>6 mos	2-8 weeks	> 1yr	>300 days
	cold (5C)	11 wks	> 1 year	>6 mos	12 days	>1 yr	>300 days
	warm (30C)	2 wks	10 wks	>6 mos	4 days	10 days	84 days
Soil	frozen	< 1 day	> 1 yr	>12 wks	2-8 weeks	>1yr	>300 days
	cold (5C)	7 wks	8 wks	12 - 28 wks	2 weeks	> 1yr	100 days
	warm (30C)	2 wks	4 wks	4 wks	1 week	10 days	2 days
Cattle Feces	Frozen	< 1 day	> 1 yr	>6 mos	2-8 weeks	>1yr	>100 days
	Cold (5C)	1 wk	8 wks	12-28wks	1-3 week	30-100 days	>100 days
	Warm (30C)	1 wk	4 wks	4 weeks	1 week	10-30 days	10 days
Slurry		1 yr	>1 yr	13-75 days	>112 days	12-28 days	10-100 days
Compost		2 wks	4 wks	7- 14 days	7 days	7 days	7 days
Dry Surfaces		1 day	1 day	1- 7 days	1 day	1 day	1 day



Hog confinement operation

Operation Storage Lagoon



Pipe covered with manure after rain.



Side of Pit that is pumped to other side for drainage to lagoon.