



Microbiology of Air

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CONTENTS:

- Aero-microbiology
- Airborne diseases.
- Sources of microorganisms in Air
- Microbes in atmosphere
- Bioaerosol

Aero-microbiology:

Definition:

“Study of living microbes suspended in air”

- Various layers present in the atmosphere at height of 1000km
- Nearest to earth is troposphere
- troposphere contains heavy load of microorganisms

Sources of microorganisms in air:

- Number of microorganisms in atmosphere but air is not a natural environment for microorganisms because it does not contain enough moisture and nutrient
- Soil sources of microorganisms:
 - Digging and ploughing the soil
 - Wind blow
- Water sources of microorganisms:
 - Splashing of water by wind action

Microorganisms are discharged out in three different forms

- Basis on their relative size
- Moisture content

Air born transmission:

Droplet:

- Droplets formed by sneezing, coughing and talking
- It consists of saliva and mucous
- It contains hundred of micro organisms which may be pathogenic mostly respiratory track origins
- Size depend of duration of time
- Pathogenic microorganisms may be a source of infectious disease

Droplet of nuclei:

- small droplets in warm and dry atmosphere evaporate rapidly and become droplet nuclei
- **Size** 1-4 μ m
- **Factors** atmospheric conditions like humidity, sunlight and temperature
- No of bacteria in a single sneeze between 10000-100000



Air born transmission:

Infectious dust:

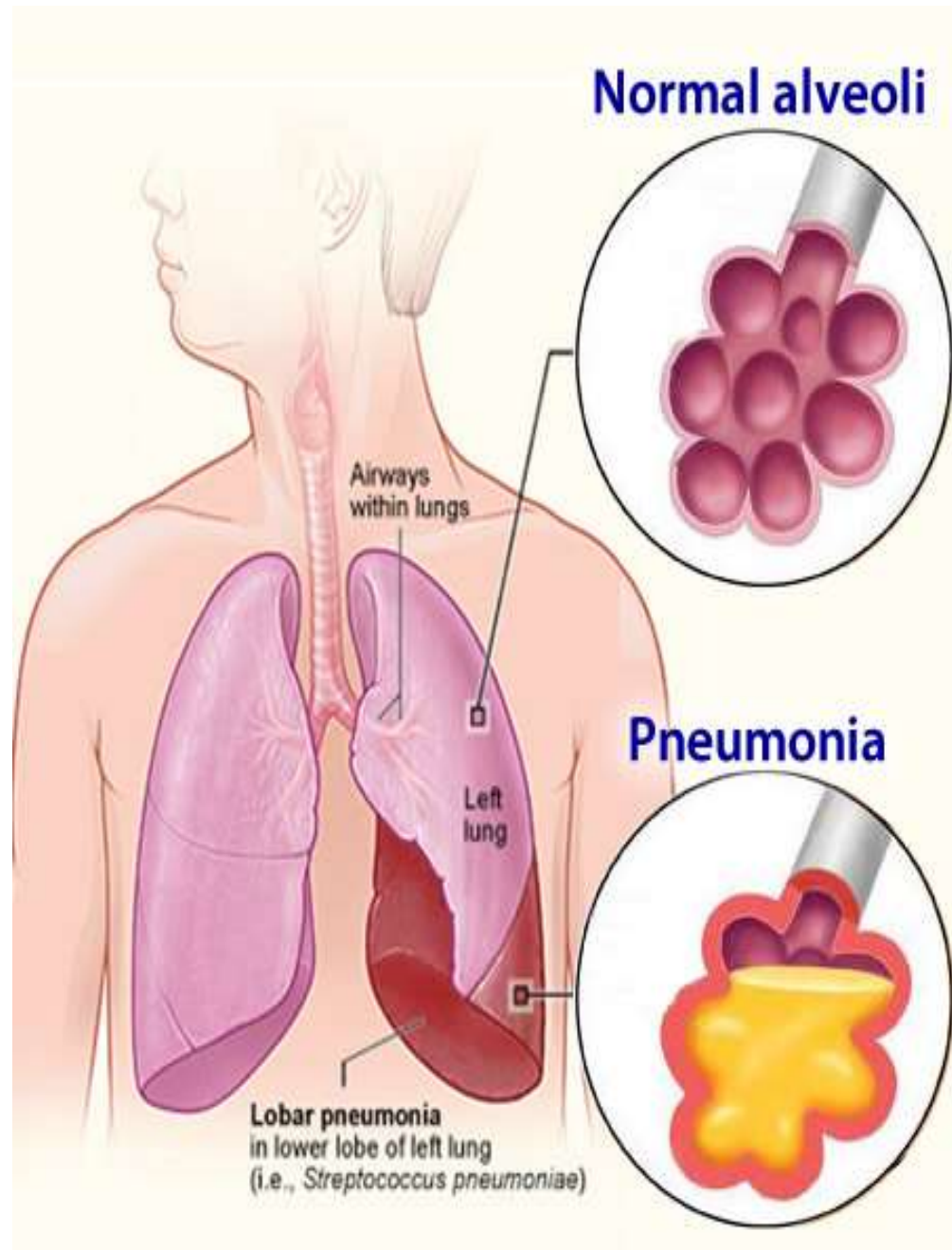
- Large aerosol droplets settle out rapidly from air
- Nasal and throat discharge from a patient
- Air born diseases transmitted by two droplets, depending upon their size
- Droplets larger than 100um in diameter
- Dried residues of droplets

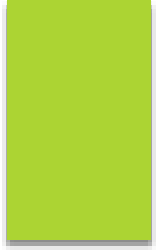
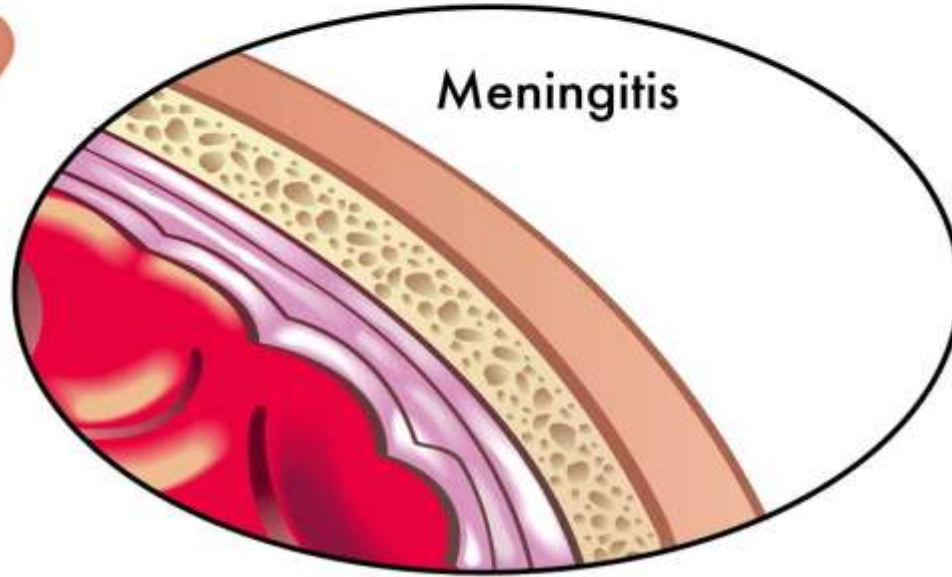
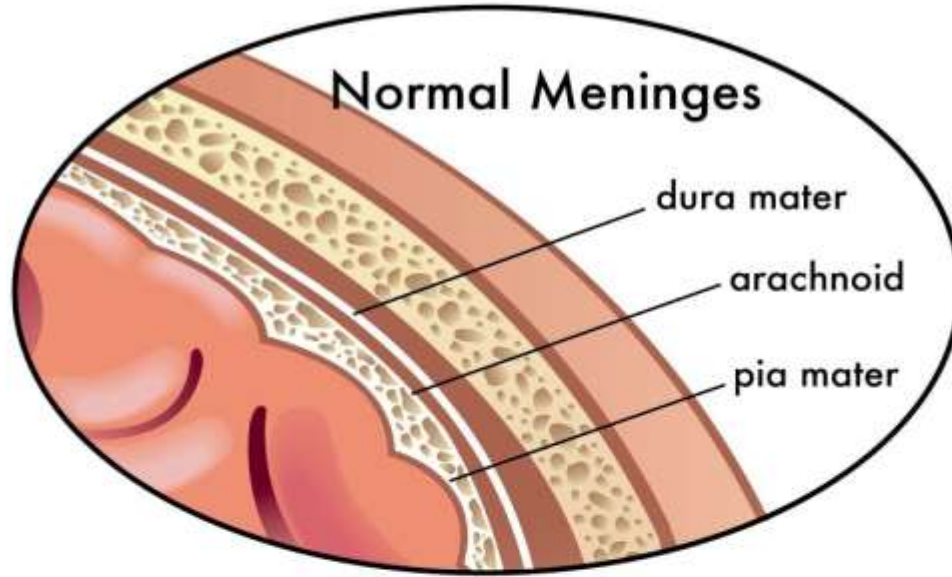
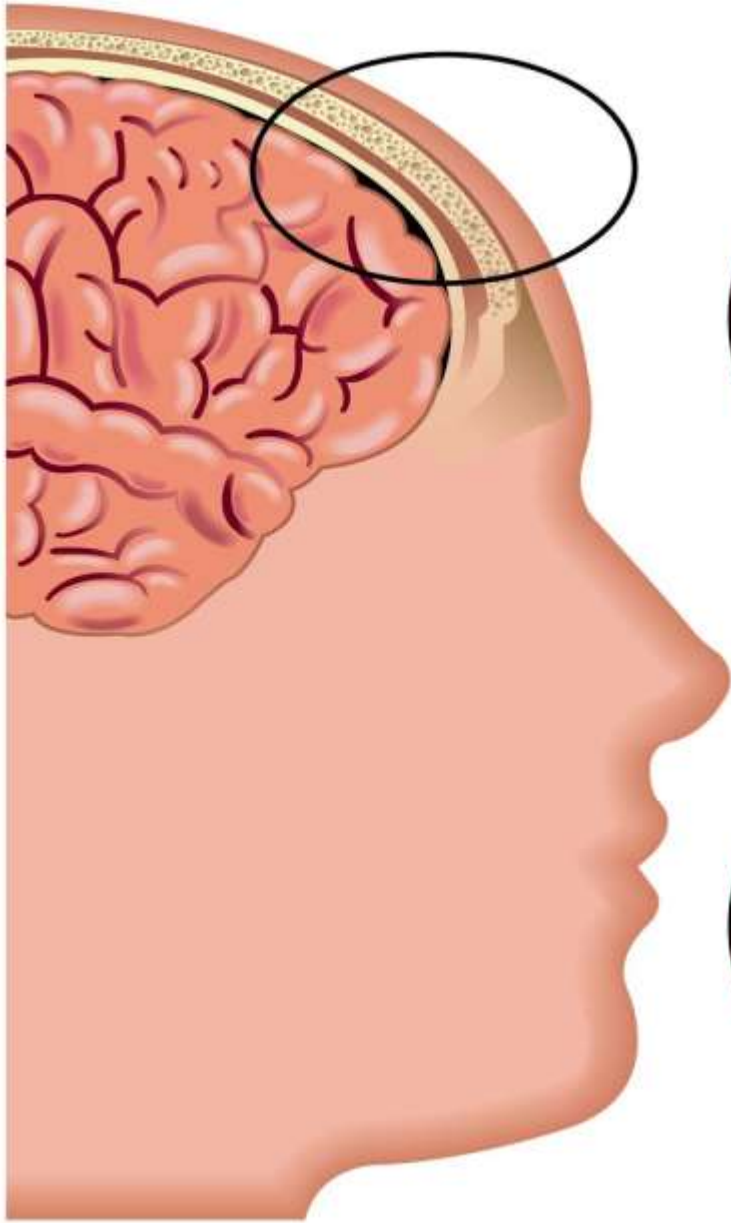
Air borne microbial diseases:

Bacterial diseases:

- **Brucellosis:** occupational disease among slaughter house workers
- **Pulmonary Anthrax:** transmission by contaminated animal products
- **Streptococcus pyogenes:** throat and skin disease
- **Rheumatic fever:** inflammation and degeneration of heart valves
- **Streptococcal pneumonia:**
- **Meningitis:** common in children
- **Diphtheria:** infection of tonsils, throat and nose
- **Tuberculosis:** respiratory disease
- **Legionellosis:** cause by natural water contamination

"Strep throat" – Pharyngitis with *Streptococcus pyogenes*:
left – petechiae; right – pus deposits





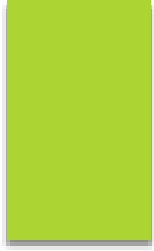
Air borne microbial diseases:

Fungal diseases:

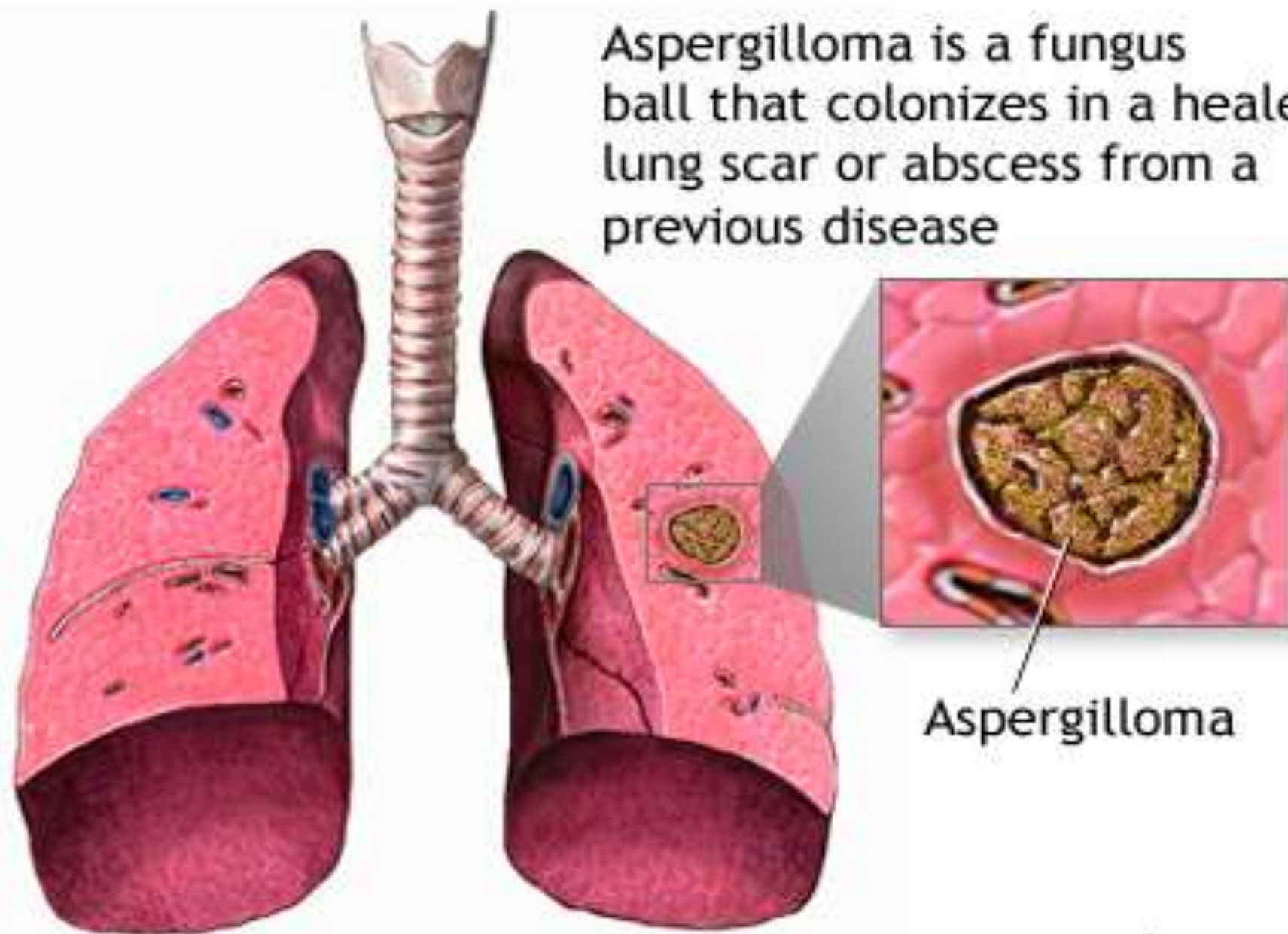
- **Cryptococcosis:** caused by inhalation of soil particles
- **Blastomycosis:** lesion formation
- **Coccidioidomycosis:** influenza fever
- **Aspergillosis:** disease of human

Viral diseases:

- **Common cold:** droplets from nose
- **Influenza:** nasal discharge, headache, muscle pains, sore throat
- **Measles:** red blotchy skin rash
- **Mumps:** swelling of parotid gland and salivary glands
- **Adeno viral diseases:** acute respiratory disease and eye infection

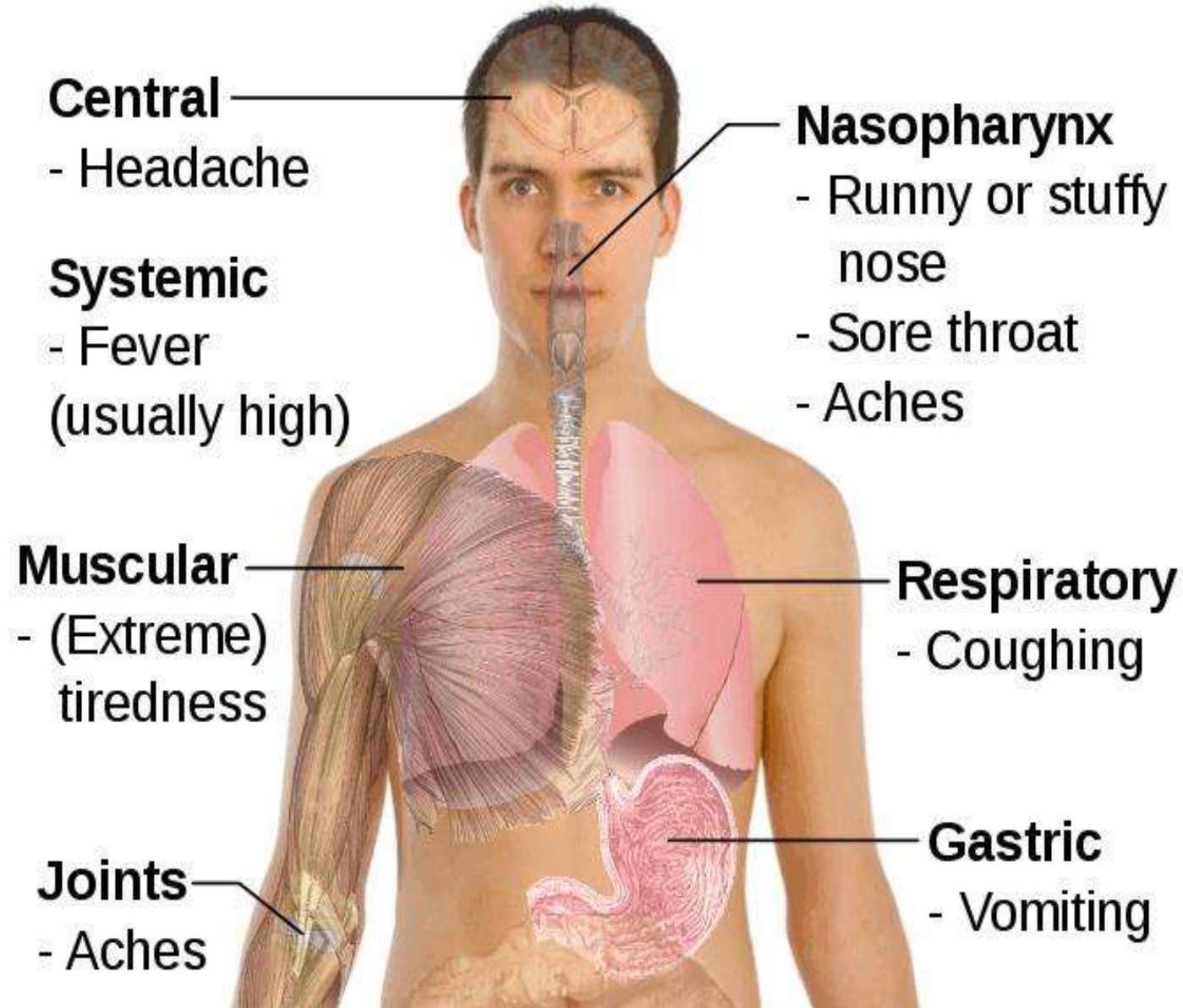


Aspergilloma is a fungus ball that colonizes in a healed lung scar or abscess from a previous disease



Aspergilloma

Symptoms of Influenza



Microbes in atmosphere:

- The atmospheric layer are important forces in determining viable particles in air
- Aero microbiological pathways AMP
- The layer of most interest and significance is the boundary layer that is 0.1km from earth surface
- Boundary layer responsible for transport of particles both short and long distances
- Boundary layer consist of three parts
- **First layer:** laminar boundary layer
- **Second layer:** turbulent boundary layer
- **Third layer:** local eddy layer

Dispersal of microbes in atmosphere:

- Dispersal begins with discharge of microbial cell, spores to the atmosphere
- Particles transport via diffusion, dispersion and deposition
- **Example:** liquid aerosol containing influenza virus
- Deposition of microorganisms occurs through three processes
- launching
- transport
- and deposition

Bioaerosol:

Definition:

“particles release from terrestrial and marine ecosystem into the atmosphere they consist of both living and non living components including organisms, dispersal method of organisms and excretion”

- Mist of dust micrometer in range
- General range from 0.02-100 μm in diameter
- **Classification on basis of size:**
- Smaller particle $<0.1\mu\text{m}$ in diameter are in nuclei mode
- Particle 0.1-2 μm are in accumulation mode
- Larger particles are coarse mode

Launching:

Definition:

“The process whereby microbes loaded particles become suspended within the earth’s atmosphere is termed launching”

factors:

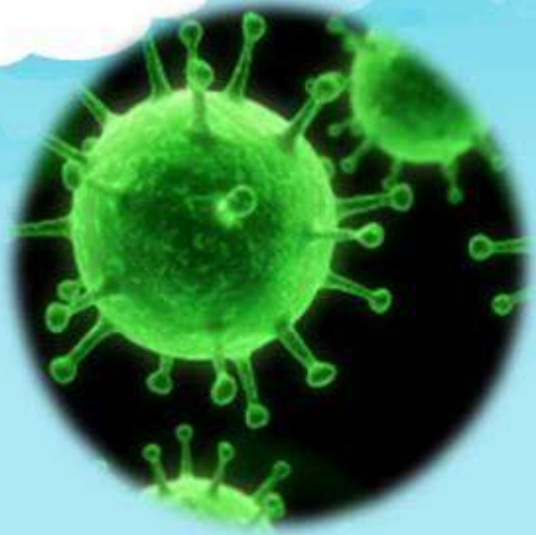
- Air turbulence
- Waste materials
- Natural mechanical process
- Release of fungal spores

Sources: terrestrial and aquatic

- Instantaneous point sources
- Continuous point sources

Bioaerosol transport:

- Transport is the process by which a viable particles move from one point to another
- Sub microscale transport involves short period of time 10mints under 100m
- Micro transport ranges 10mints to 1 hour and 100m to 1km
- Estimation by using Osbert Reynolds method
- $Re = \text{velocity} \times \text{dimension} \text{ viscosity}$



Bioaerosol deposition:

- Regarded as the Last step in AMB pathway
 - Rate of deposition of a particle is directly proportional to its mass, volume and mass/volume ratio
- 1 Gravitational sittings:**
- Microbial particles that are exposed to wind above 8×10^3 m/hrs then gravitational deposition may be negligible
- 2 Downward molecular diffusion:**
- Natural air currents
 - Force of winds
 - Deposition rate
- 3 Surface impaction:**
- Particles make contact with surfaces such as leaves, tree, wall and furniture
 - Causes:
 - Allow downward molecular diffusion and gravitational setting
 - Allow particles to escape the surface

Bioaerosol deposition:

4. Rain and electrostatic deposition:

- Rainfall occurs as a condensation reaction b/w two particles which combine and create bioaerosol with a greater mass making it to settle faster
- Microorganism have negative charge due to which they associates with positive charged air borne particles resulting in electrostatic condensation