Gram Positive Bacteria

Bacillus

Course instructor: Soran Kayfi

E-mail: soran.kayfi@tiu.edu.iq

Course: Medical Microbiology (MA 212)

Summer Semester

Week 4

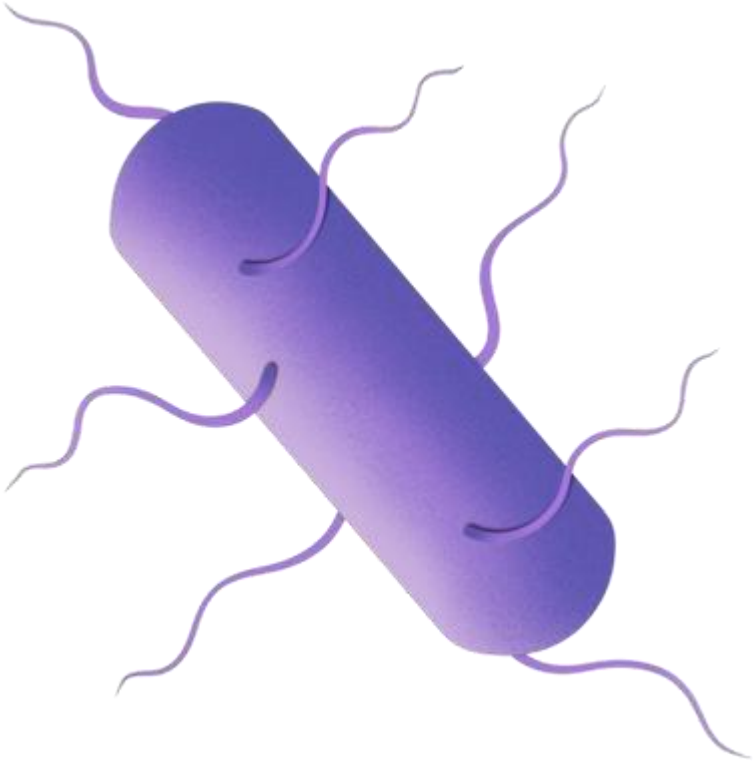
Outline

- Gram Positive Bacteria
- **Bacillus**

General Characteristics of ***Bacillus***

- Gram-positive,
- rod-shaped bacteria
- Spore-forming (survival in harsh environments)
- Aerobic or facultative anaerobes
- Found in soil, water, dust, and food

- Pathogenic species: *B. anthracis, B. cereus*



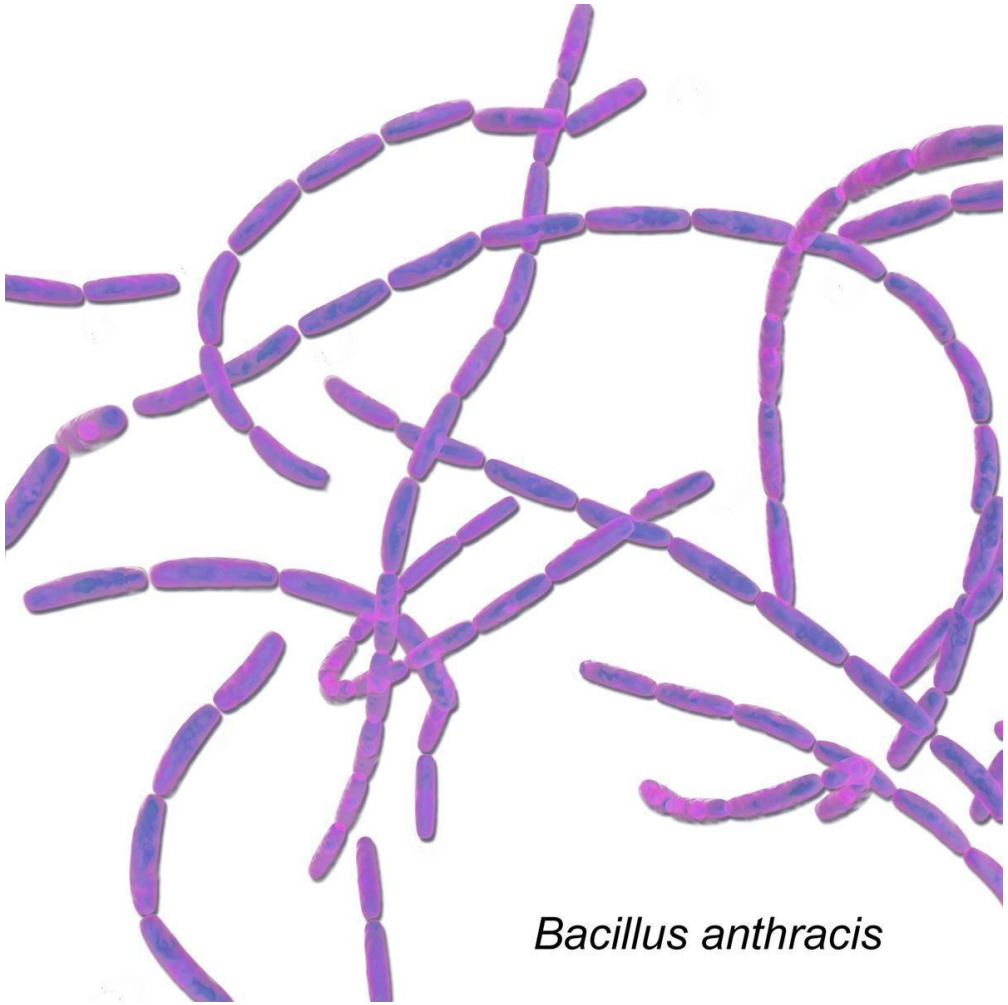
Famous Bacillus Species

- *B. anthracis*, which causes anthrax, has capsule

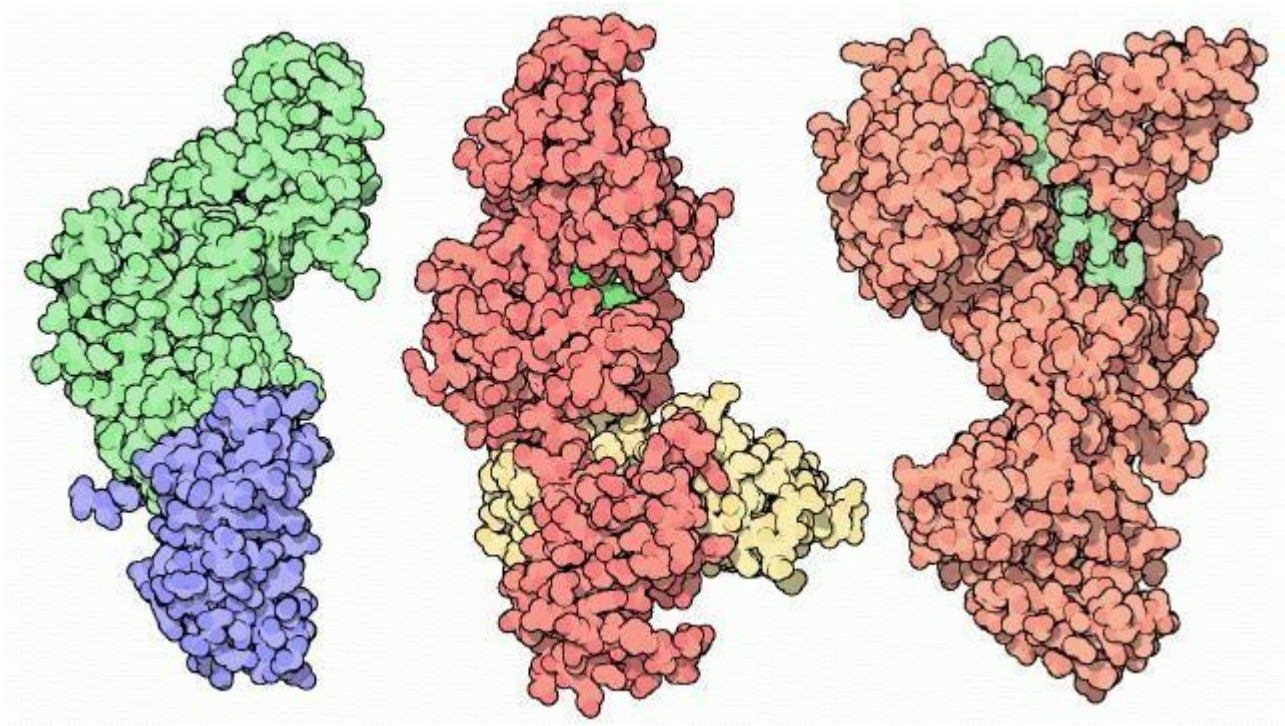
- *B. cereus*, which causes a foodborne illness no capsule.

- *B. subtilis*, an important model organism. It is also a notable food spoiler; it is also one of the contaminants of culture media in bacteriology laboratories.

- Medically useful antibiotics are produced by *B. subtilis* (bacitracin).



Bacillus anthracis



Anthrax Toxin

➢ *Bacillus anthracis*

Characteristics

- is a 1- Gram-positive 2- spore-forming, 3- rod-shaped bacterium. *Bacillus anthracis* spores in particular are highly resilient, surviving extremes of temperature, low- nutrient environments, and harsh chemical treatment over decades or centuries. 4- has capsule. 5- arrangement in chain.
- It is the causative agent of anthrax

Three types of anthrax:

1. Cutaneous anthrax (malignant pustule).
2. Pulmonary anthrax (wool sorter's disease) and
3. Gastrointestinal anthrax.

Bacillus anthracis

- is a Gram-positive spore-forming, rod-shaped bacterium**.** *Bacillus anthracis* spores in particular are highly resilient, surviving extremes of temperature, low-nutrient environments, and harsh chemical treatment over decades or centuries.
- It is the causative agent of anthrax

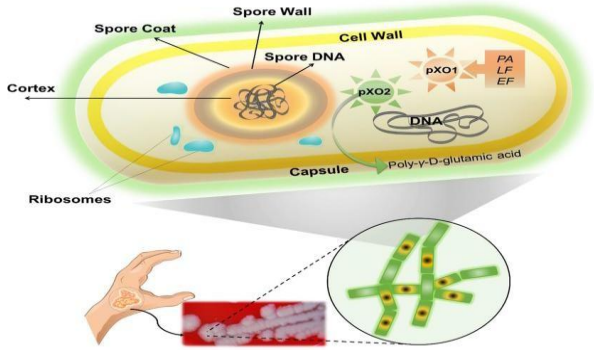
Three types of anthrax:

1. **Cutaneous anthrax** also called (malignant pustule).
2. **Pulmonary anthrax** (**wool sorter's** disease) and
3. **Gastrointestinal anthrax.**

➢ Virulence Factors and Pathogenesis

The pathogenesis depends on **two** important **virulence factors**:

- **Capsule**: interfere with phagocytosis, loss of plasmid which control capsule production leads to loss of virulence



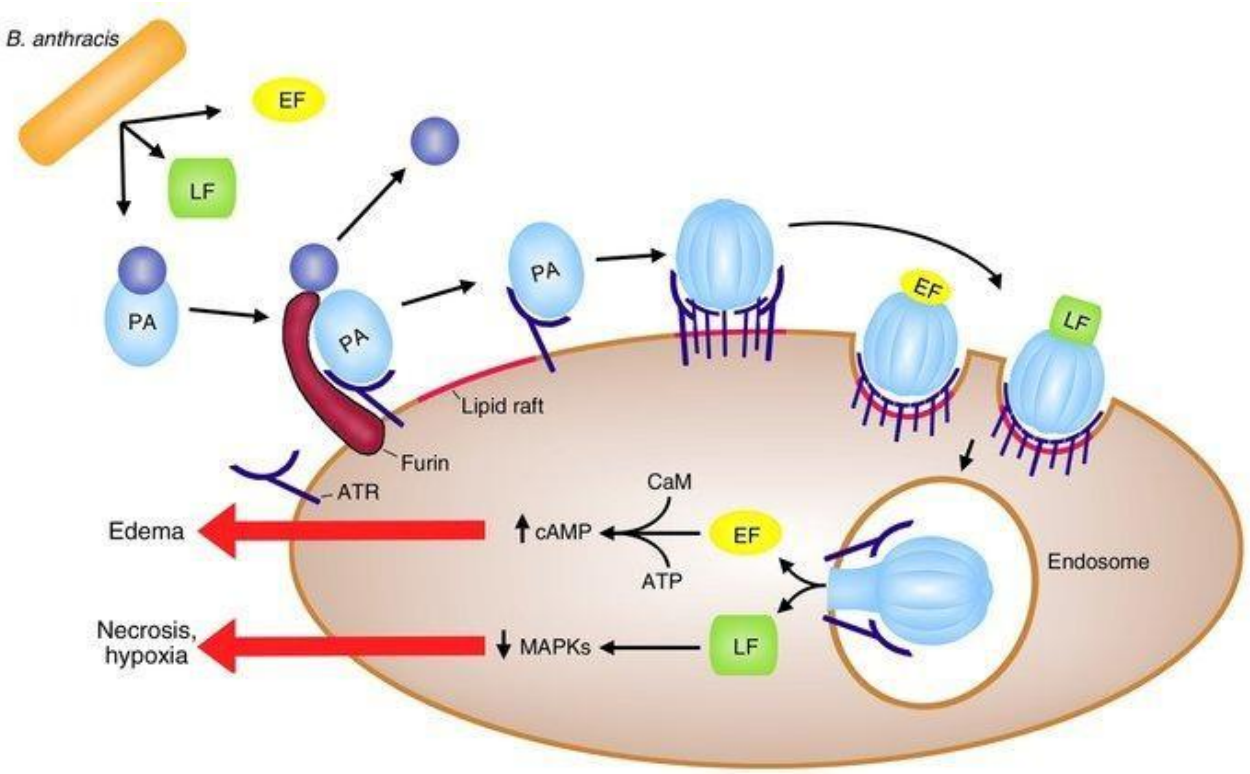
- **Anthrax Toxin**: Three component protein exotoxin

1- Edema factor causes edema or (fluid retention) Acts as adenylyl cyclase →increases host cell cAMP in host.

Note Edema is the build-up of fluid in the body's tissue.

3- Protective antigen - Binding fragment. Binds to the host cell receptors and facilitates the entry of other fragments into the host cells.

3- Lethal factor - Causes cell death - Acts by cleaving host cell MAPK (mitogen- activated protein kinases).



[Cutaneous anthrax ulcer on the wrist with marked edema.]

Anthrax Toxin Work

➢ Cutaneous anthrax

- When anthrax spores get into the skin, usually through a cut or scrape, a person can develop cutaneous anthrax.

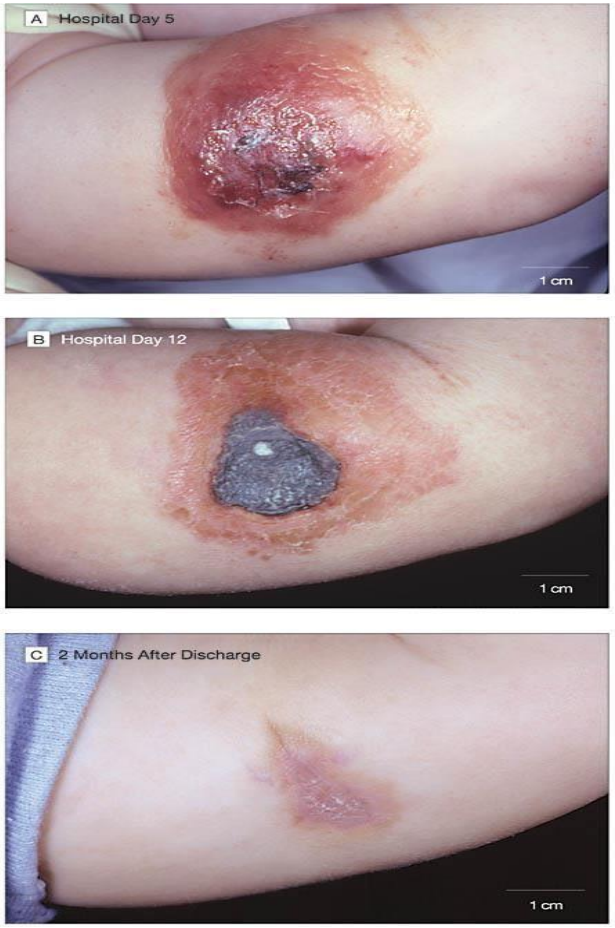
- This can happen when a person handles infected animals or contaminated animal products like wool, hides, or hair.

- Cutaneous anthrax is most common on the head, neck, forearms. and hands. It affects the skin and tissue around the site of infection.

- A group of small blisters or bumps that may itch Swelling can occur around the sore

- A painless skin sore (ulcer) with a black center that appears after the small blisters or bumps

  - Most often the sore will be on the face, neck, arms, or hand

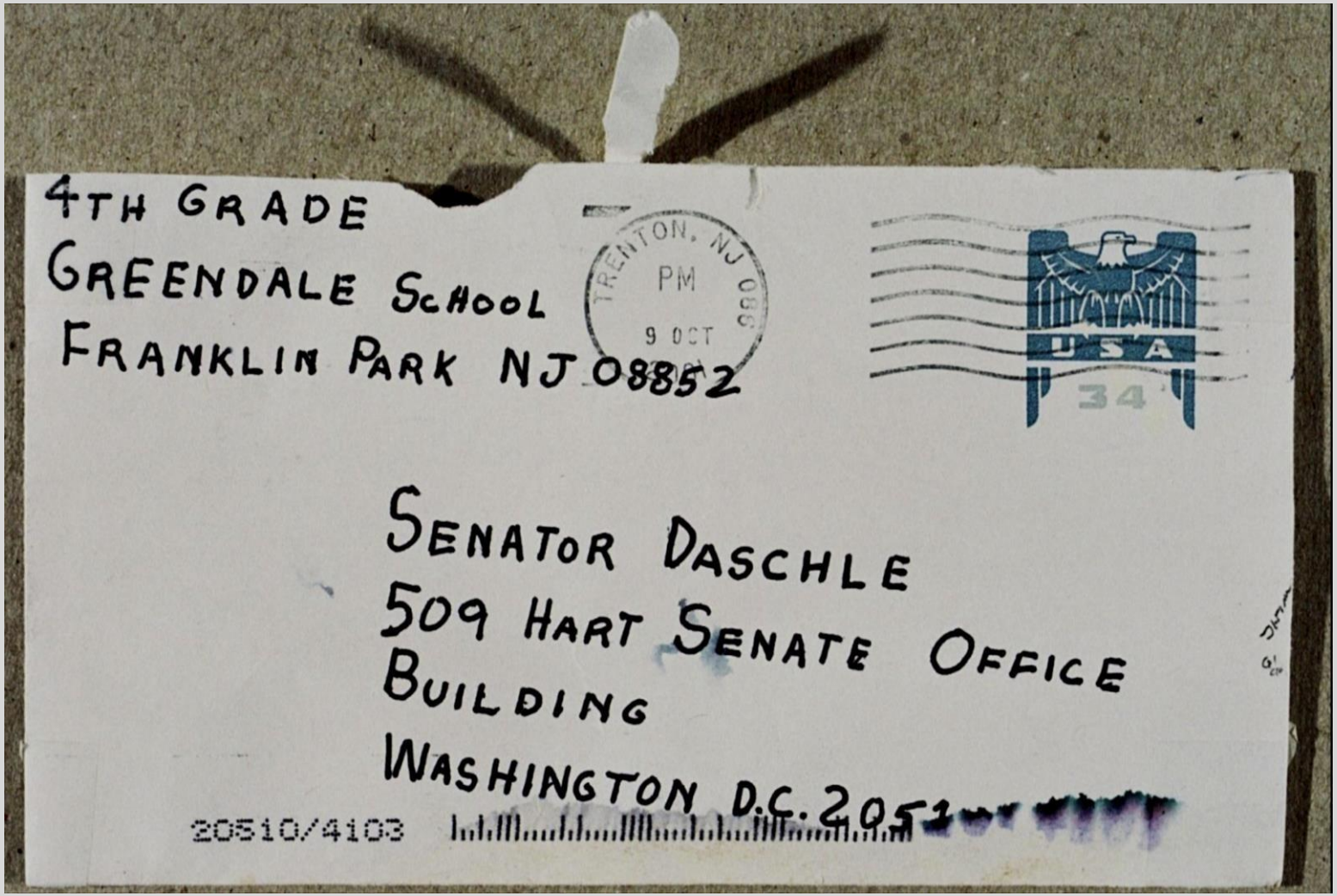


Cutaneous anthrax

➢ Inhalational anthrax.

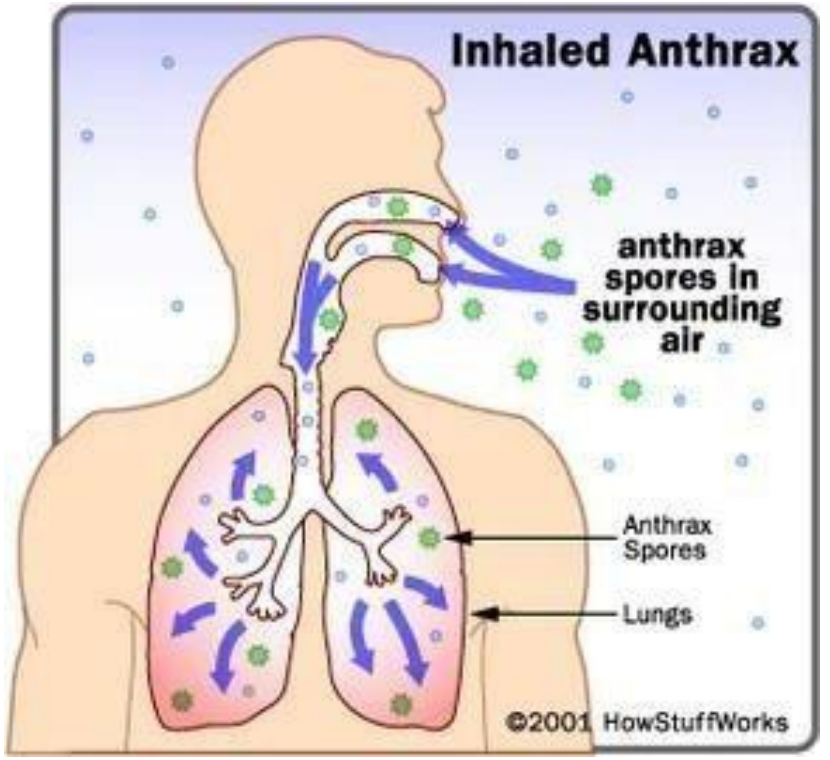
- When a person breathes in anthrax spores, they can develop inhalation anthrax.
- People who work in places such as wool mills, slaughterhouses, and tanneries may breathe in the spores when working with infected animals or contaminated animal products from infected animals.

- Inhalation anthrax starts primarily in **the lymph nodes** in the chest before spreading throughout the rest of the body, ultimately causing severe breathing problems and shock.
- Without treatment, inhalation anthrax is almost always **fatal**.
- Because of the resilience of the endospore, the bacterium is one of the most popular biological weapons


4TH GRADE
GREENDALE SCHOOL
FRANKLIN PARK NJ 08852
TRENTON, NJ 086
PM
9 OCT
USA
34
SENATOR DASCHLE
509 HART SENATE OFFICE
BUILDING
WASHINGTON D.C. 2051
20510/4103

Inhalation anthrax symptoms can include:

- Fever and chills
- Chest Discomfort
- Shortness of breath
- Confusion or dizziness
- Cough
- Nausea, vomiting, or stomach pains
- Headache
- Sweats (often drenching)
- Extreme tiredness
- Body aches



Gastrointestinal anthrax

- When a person eats raw or undercooked meat from an animal infected with anthrax, they can develop gastrointestinal anthrax.

- After ingesting, anthrax spores can affect the upper gastrointestinal tract (throat and esophagus), stomach, and intestines, causing a wide variety of symptoms.

Bacillus cereus

- Bacillus cereus is the second Bacillus species of interest in human diseases. It is ubiquitous in nature and can easily contaminate various raw or processed foods or damaged human skin.

- Bacillus cereus is a large Gram-positive bacillus with four major properties, differentiating it from B. anthracis: motility, hemolysis, absence of capsule and resistance to penicillin .

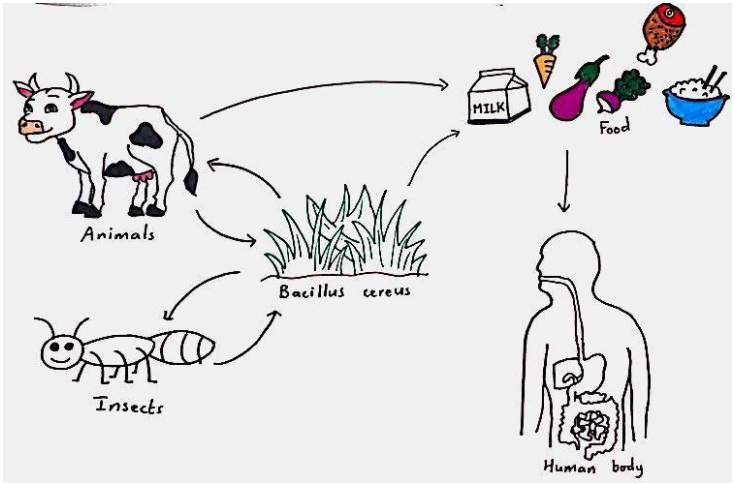
- Widely isolated from vegetables, milk, cereals, spices, meat & poultry,

causes Food poisoning Two toxins:

1- **Edema Toxin 2- Diarrheal Toxin**

- Emetic Toxins (toxin mediated): heat stable enterotoxin, cytotoxic toxin releases to food (causes diarrheal type of food poisoning)
- Nausea, Vomiting, abdominal cramps,
- Symptoms within 1- 6hrs

- Diarrheal Toxin, heat labile enterotoxin, stimulate adenylate cyclase (makes watery diarrhea)
- Symptoms after 18 hrs.



Transmission pathways of B. cereus,