# **Bacillus Species (Aerobic, Spore-Forming Gram-Positive Rods)**

**Characteristics:**

* *Bacillus* species are large Gram-positive rods that **form endospores**.
* **catalase positive**
* most are aerobes or facultative anaerobes.
* Colonies on blood agar are often large, spreading, and may be β-hemolytic (with the notable exception of *Bacillus anthracis*).
* Many *Bacillus* produce pigments (e.g. *B. subtilis* can be dull yellow).

**Key Identification Points:**

**Bacillus anthracis (Anthrax):**

* **Non-hemolytic** on sheep blood agar (no hemolysis, unlike most Bacillus).
* **Non motile** unlike other bacillus
* **Frosted ground glass appearance with irregular edges**
* Colonies have a distinctive **“Medusa head”** - they are tenacious (stand up when lifted with a loop).
* Cells are large rods often seen in chains, and in patient specimens
* can show a **characteristic capsule** > visible in direct smears with **McFadyean’s** stain).
* It is also **lecithinase positive** on egg yolk agar
* susceptible to penicillin (historical “**string-of-pearls**” test: in presence of low-dose penicillin on agar, *B. anthracis* forms a chain of spherical cells).
* Lysis by gamma phage
* If *B. anthracis* is suspected (from clinical context like widened mediastinum in inhalational anthrax, or necrotic eschar in cutaneous anthrax), identification must be confirmed at reference labs with PCR or DFA for capsule and toxin genes, and it is handled under high containment.

**Bacillus cereus group:** *B. cereus* (and relatives like *B. thuringiensis*, *B. mycoides*)

* typically **β-hemolytic** on blood agar and **motile** (peritrichous flagella).
* Colonies of *B. cereus* are large, feathery or spreading, and often grayish.
* *B. cereus* is **lecithinase positive** (opaque zone on egg yolk agar)
* **penicillin resistant**.
* It is a well-known cause of
  1. food poisoning. (emetic toxin – heat stabile cf diarrheal types – heat labile)
  2. cause eye infections
  3. SSTI (esp haemonc or post RTA, outbreaks)
  4. Outbreaks of surgical site infection due to spore contamination of surgical equipment
  5. Outbreaks of poisoining from neonatal TPN feed

**Other Bacillus:**

* Many other Bacillus species (like *B. subtilis*, *B. licheniformis, B thuringiensis, B. mycoides, B. pumilis*) are environmental contaminants.
* They are usually motile and hemolytic.
* They are of low virulence, though *B. subtilis* can rarely cause infections in immunocompromised or contaminate blood cultures. Some Bacillus (e.g. *B. pumilus*)
* **Bacillus mycoides** has special colony morphologies (e.g. *B. mycoides* has a swirled colonial pattern)

**Identification Algorithm:**

1. An aerobic Gram-positive rod that forms spores:
2. Check **hemolysis and motility**.
   * If **non-hemolytic and non-motile**, suspect *B. anthracis* – handle with caution and perform confirmatory tests (like DFA for capsule, lysis by gamma phage, or PCR).
   * If **β-hemolytic and motile**, *Bacillus anthracis* is essentially ruled out, and the isolate is likely another *Bacillus* (such as *B. cereus*).
3. **Penicillin susceptibility:** *B. anthracis* is usually susceptible whereas *B. cereus* group is resistant. This test can support differentiation, but modern labs use PCR for confirmation of anthrax. 3
4. Use **egg yolk agar** for lecithinase (opaque zone indicates *B. cereus* group or *B. anthracis*). A
5. Automated identification systems or MALDI-TOF can identify *Bacillus* species if needed for infection control or epidemiology or environmental Bacillus species are often identified by exclusion (if it’s not anthrax and not a classic food-poisoning scenario, many labs would not speciate further).

**Clinical Note:** Recognizing *B. anthracis* is critical due to its potential use in bioterrorism and severity of disease. *B. cereus* is a common cause of foodborne illness (reheated rice syndrome) and can cause serious infections in intravenous drug users or immunosuppressed patients. Most other Bacillus are considered contaminants unless repeatedly isolated or from a sterile site with signs of infection.