

# AI-03106 Motility

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## 1. What is Motility?

Motility refers to the ability of an organism, cell, or organ to move independently using metabolic energy. It is a fundamental biological property observed in various contexts such as:

- Cellular motility – movement of cells (e.g., white blood cells, sperm cells, bacteria).
- Organ motility – contraction and movement within organs (e.g., peristalsis in the gastrointestinal tract).
- Microbial motility – locomotion mechanisms used by bacteria, protozoa, or other microorganisms.

Motility is different from mobility:

- Motility = self-generated movement (active).
- Mobility = ability to be moved by external forces (passive).

## 2. Deep Dive by Context

Type of Motility	Description	Mechanism
Cellular (Eukaryotic)	Movement of eukaryotic cells like immune cells or cancer cells.	Actin and myosin cytoskeleton dynamics, ATP-driven.
Sperm Motility	Ability of sperm to swim toward the egg for fertilization.	Flagellar movement powered by ATP in mitochondria.
Bacterial Motility	Movement of bacteria in liquid or on surfaces.	Rotating flagella, pili-based "twitching," gliding, or corkscrew

		(spirochetes).
Gastrointestinal Motility	Contractions moving food through digestive tract.	Smooth muscle peristalsis coordinated by the enteric nervous system.
Ciliary Motility	Coordinated beating of cilia in respiratory tract or fallopian tubes.	Dynein-motor-driven movement using ATP.

### 3. What Measures Motility?

The measurement of motility depends on the biological system.



#### A. Sperm Motility

- Measured in % of moving sperm and categorized as:
  - Progressive motility: Forward directional movement.
  - Non-progressive motility: Movement without forward progression.
  - Immotile: No movement.
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- Normal WHO standard (2021):
  - Total motility  $\geq 40\%$
  - Progressive motility  $\geq 32\%$
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- Tools: Computer-Assisted Sperm Analysis (CASA), Light microscopy.



#### B. Bacterial Motility

- Measured by:
  - Motility agar test (0.3–0.5% agar): Bacteria spread outward from stab line = motile.
  - Microscopy (hanging drop/wet mount): Observe real-time movement.
  - Swarming/swimming zones (diameter in mm) on agar plates.

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- Types assessed: Swimming, swarming, twitching, gliding.



### C. Gastrointestinal Motility

- Measured using:
  - Manometry: Pressure sensors detect muscular contraction patterns.
  - Scintigraphy: Radio-labeled food to measure gastric emptying time.
  - Wireless motility capsule (SmartPill): Measures pH, pressure, temperature through GI tract.
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- Metrics: Contraction frequency, wave amplitude, gastric emptying time.



### D. Single-Cell Motility (Immunology & Cancer Biology)

- Measured as:
  - Velocity ( $\mu\text{m}/\text{min}$ ) – displacement of a cell divided by time.
  - Chemotaxis index – movement toward chemical signals.
  - Mean squared displacement (MSD) from time-lapse microscopy.
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#### 4. Why Is Motility Important?

System	Importance of Motility
Immune System	White blood cells must migrate to infection/injury sites.
Reproduction	Sperm must swim to fertilize the egg; Fallopian tube cilia transport the egg.
Digestive System	Peristalsis mixes food and moves it along the GI tract.
Bacteria	Helps find nutrients, escape immune attack, colonize surfaces.
Cancer Biology	Metastasis requires motile cancer cells to migrate and invade tissues.

## 5. Summary (Quick Answer)

- Motility = The biological ability to actively move using energy.
- Measured by:
  - % moving cells (e.g., sperm)
  - Displacement or speed ( $\mu\text{m}/\text{sec}$ )
  - Pressure waves (GI motility)
  - Diffusion in soft agar (bacteria).
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- Involves cytoskeleton, flagella, cilia, muscle contractions.
- Crucial in reproduction, digestion, immunity, microbial survival, and cancer spread.

Would you like me to focus deeper on sperm motility, bacterial motility tests, or GI motility disorders?