An **endosome** is a **membrane-bound compartment** inside eukaryotic cells that plays a key role in **sorting and transporting internalized material**. It's part of the **endocytic pathway**, which is how cells take in molecules from their surroundings.

—

□ What does an endosome do?

Endosomes are responsible for:

- **Sorting internalized molecules** (like nutrients, receptors, and pathogens) - **Transporting cargo** to different destinations:

1. Back to the **plasma membrane** (recycling)
2. To the **Golgi apparatus**
3. To **lysosomes** for degradation

—

□ Types of Endosomes

1. **Early endosomes**

1. First station after internalization
2. Mildly acidic
3. Decide whether cargo gets recycled or degraded

2. **Late endosomes**

1. More acidic
2. Fuse with lysosomes for degradation

3. **Recycling endosomes**

1. Return cargo (like receptors) back to the plasma membrane

—

□ Role in Immunity

Endosomes are crucial in **nucleic acid-mediated signaling**, especially:

- **TLR3, TLR7, TLR8, and TLR9** are located in **endosomal membranes** - They detect **viral RNA or DNA** inside endosomes, triggering **immune responses**

—

□ Clinical relevance

- Pathogens (like viruses) may **exploit endosomes** to enter cells - Dysregulated endosomal trafficking is linked to **neurodegenerative diseases** and **autoimmunity** - Therapeutic delivery systems (e.g., **mRNA vaccines**) often target **endosomal uptake**