Antigen Processing and Presentation

Complex Antigens Are Degraded (Processed) and Displayed (Presented) with MHC Molecules on the Cell Surface

- In order for a foreign protein antigen to be recognized by a T cell, it must be degraded into small antigenic peptides that form complexes with class I or class II MHC molecules.
- This conversion of proteins into MHC-associated peptide fragments is called *antigen processing and presentation.*
- Whether a particular antigen will be processed and presented together with class I MHC or class II MHC molecules appears to be determined by the route that the antigen takes to enter a cell

Exogenous antigen

- **Exogenous antigen** is produced outside of the host cell and enters the cell by endocytosis or phagocytosis.
- Antigen presenting cells (macrophages, dendritic cells, and B cells) degrade ingested exogenous antigen into peptide fragments within the endocytic processing pathway.
- Experiments suggest that class II MHC molecules are expressed within the endocytic processing pathway and that peptides produced by degradation of antigen in this pathway bind to the cleft within the class II MHC molecules.
- The MHC molecules bearing the peptide are then exported to the cell surface.
- Since expression of class II MHC molecules is limited to antigen-presenting cells, presentation of exogenous peptide–class II MHC complexes is limited to these cells.
- T cells displaying CD4 recognize antigen combined with class II MHC molecules and thus are said to be *class II MHC restricted.*
- These cells generally function as T helper cells.

Endogenous antigen

- Endogenous antigen is produced within the host cell itself.
- Two common examples are viral proteins synthesized within virus-infected host cells and unique proteins synthesized by cancerous cells.
- Endogenous antigens are degraded into peptide fragments that bind to class I MHC molecules within the endoplasmic reticulum.
- The peptide–class I MHC complex is then transported to the cell membrane.
- Since all nucleated cells express class I MHC molecules, all cells producing endogenous antigen use this route to process the antigen.
- T cells displaying CD8 recognize antigen associated with class I MHC molecules and thus are said to be class I MHC restricted.
- These cytotoxic T cells attack and kill cells displaying the antigen–MHC class I complexes for which their receptors are specific.

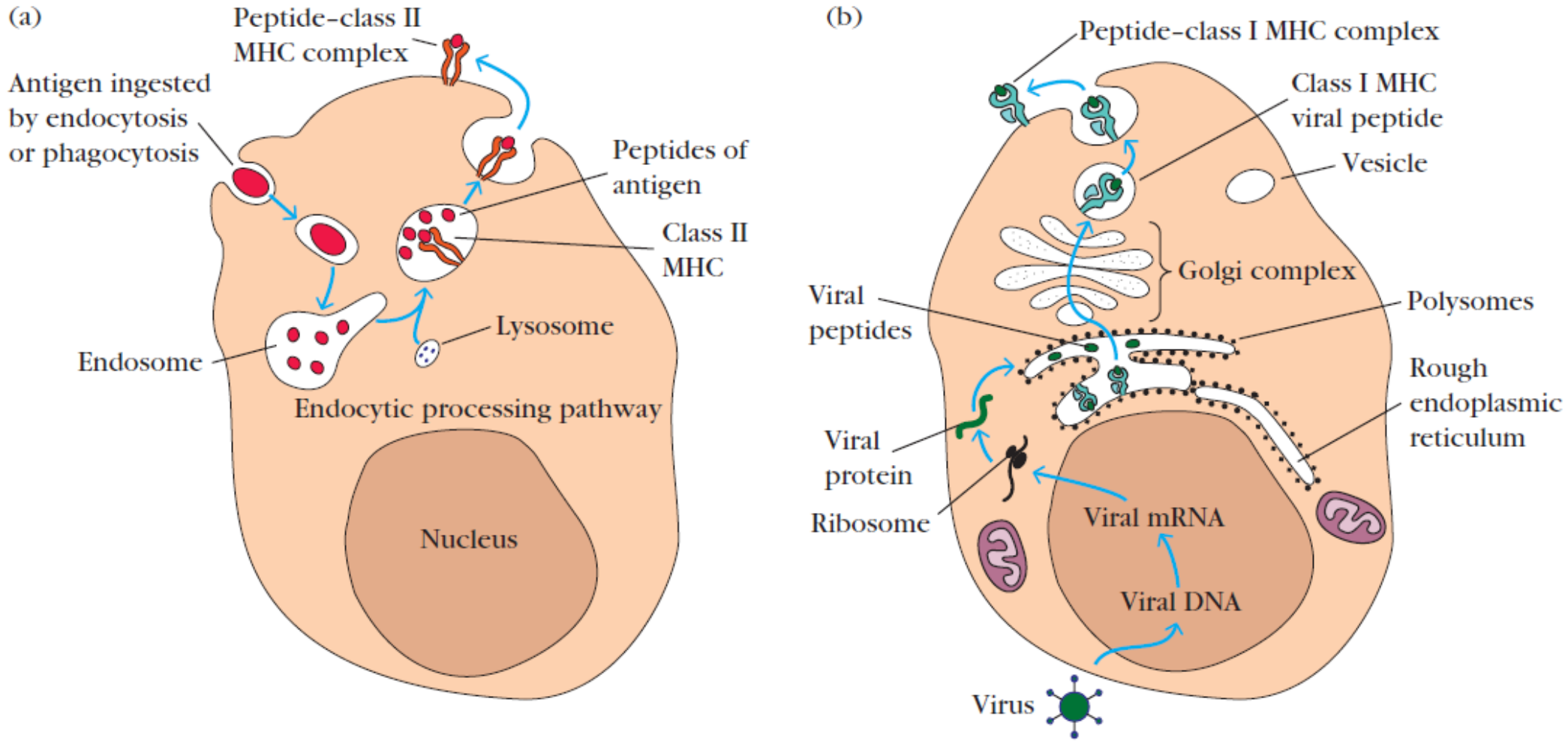

FIGURE 1-9 Processing and presentation of exogenous and endogenous antigens. (a) Exogenous antigen is ingested by endocytosis or phagocytosis and then enters the endocytic processing pathway. Here, within an acidic environment, the antigen is degraded into small peptides, which then are presented with class II MHC molecules on the membrane of the antigen-presenting cell. (b) Endogenous antigen, which is produced within the cell itself (e.g., in a virus-infected cell), is degraded within the cytoplasm into peptides, which move into the endoplasmic reticulum, where they bind to class I MHC molecules. The peptide–class I MHC complexes then move through the Golgi complex to the cell surface.