where it undergoes further processing before being delivered to a lysosome. (Section 10-2D)

6. Synthesis of a cell-surface glycoprotein follows the same process described for a lysosomal protein in Study Exercise 5, up to the point of translocating through the ER membrane into the lumen. The protein destined for the cell surface is not completely extruded into the lumen but remains anchored in the membrane via an ~20-residue hydrophobic membrane anchor, with its N-terminal "extracellular" portion in the lumen and its C-terminal portion in the cytoplasm. A vesicle buds off from the ER and moves to the Golgi apparatus, carrying the membrane-bound protein with it. In the Golgi apparatus, the protein, which already bears a carbohydrate chain added in the ER, undergoes further glycosylation. A coated vesicle then transports the protein to the cell surface. After fusion of the vesicle and plasma membranes, the membrane-anchored protein becomes a cell-surface protein with its glycosylated domain exposed to the extracellular space. (Section 10-2D)

7. LDL is a protein–lipid complex that carries cholesterol as part of its solvent-exposed surface and cholesteryl esters in its hydrophobic interior. The lipoprotein travels in the bloodstream until an LDL receptor on a cell recognizes the apoB-100 protein component of the LDL. Receptor-bound LDL particles cluster into coated pits and are then engulfed by the cell through endocytosis. The resulting vesicle, which contains the LDL, fuses with an endosome, whose low pH induces the LDL to dissociate from its receptor. The LDL receptors are recycled to the cell surface while the apoB-100 is degraded and the lipids, including cholesterol, are released for use by the cell. (Section 10-3)

8. The mediated transport of a substance across a biological membrane occurs through the action of a carrier molecule, which is usually a protein. Mediated transport may be driven by a concentration gradient such that the substance moves across the membrane from a region of high concentration to a region of low concentration. Alternatively, mediated transport may require the input of free energy from another exergonic process. Nonmediated transport of a substance across a membrane does not require a carrier molecule and occurs by simple diffusion according to the concentration gradient of the substance. (Section 10-4)

9. Ionophores, porins, and passive-mediated transport proteins all mediate the transmembrane movement of a substance that cannot pass through the membrane on its own due to its size and/or polarity. In all cases, the substance can cross the membrane in either direction, provided that it moves according to its chemical potential difference, and no other source of free energy is required. The three transporter differ in their structure and mechanism. Ionophores include small ion-binding molecules that can diffuse through a membrane, and small polypeptides that form a transmembrane channel through which an ion can diffuse. Porins are integral membrane proteins that form transmembrane channels that are always "open." However, the geometry of the channel and the amino acid residues lining it exert some solute selectivity. Transport proteins, unlike always-available ionophores and porins, do not have a single, always-open conformation. Instead, they alternate between two conformations. This allows the protein to bind a substance on one side of the membrane and change conformation so as to release it on the other side. (Section 10-4B)