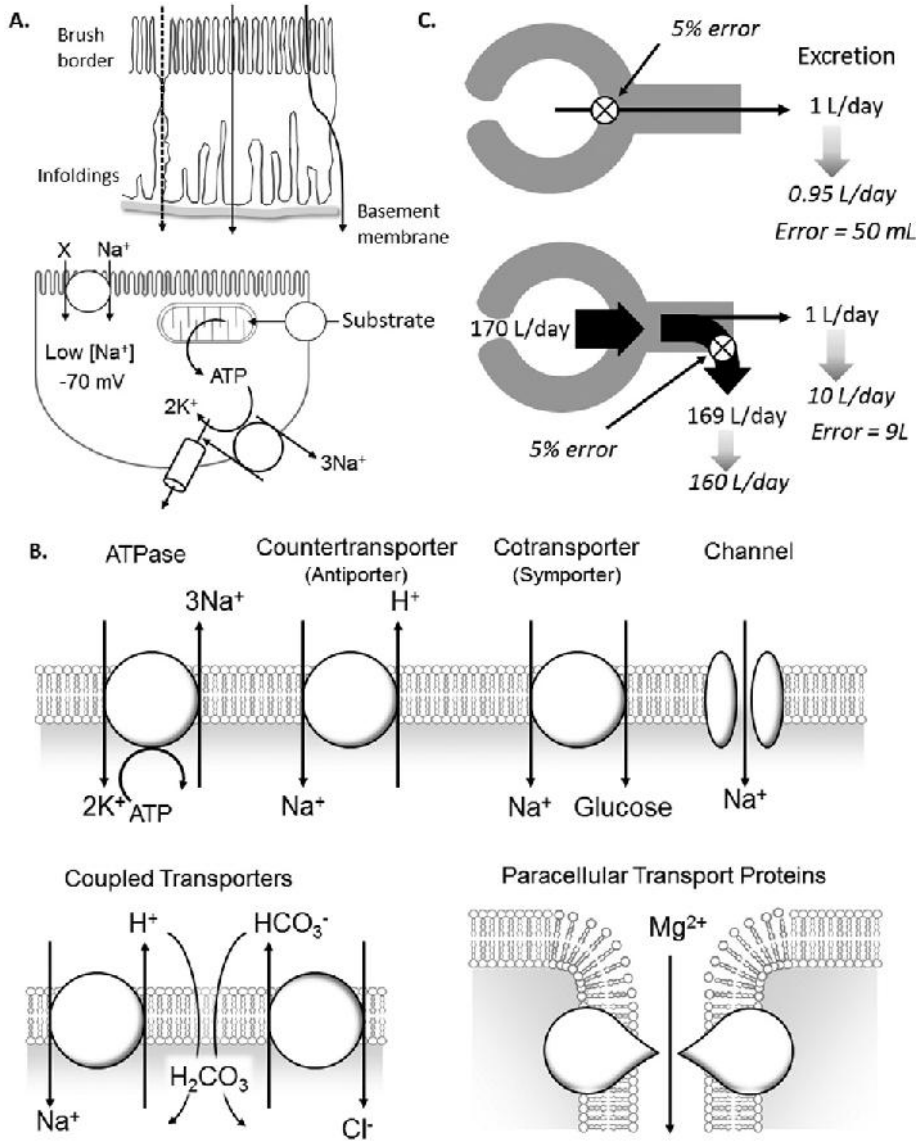

FIGURE 25-2 **A,** *Top,* Transcellular and paracellular transport of solutes. Solute transport is an energy-consuming process that requires metabolic fuels; a sodium cotransporter and a sodium-potassium countertransporter are shown. **B,** Transport proteins. *Top,* Adenosine triphosphatases (ATPases) directly couple ATP hydrolysis to transport. Cotransporters (symporters) move two solutes in the same direction, and countertransporters (antiporters) move two different solutes in opposite directions. Channels function as protein-lined "holes" that allow specific solutes to permeate. *Lower left,* Different transporters can be coupled together to form a new transport system. *Lower right,* Proteins that protrude outside the cell in the junctional area provide a conduit for paracellular transport. C, Comparison of a pure filtration (or secretion) design *(top)* and a filtration-reabsorption design *(bottom)*. See text for details.

outside the glomerulus, is called the *juxtaglomerular apparatus* (JGA) (see Fig. 25-1C). The JGA is an important structure in the maintenance of GFR by tubuloglomerular feedback and is the site of endocrine renin production.

RENAL FUNCTION

Excretory Function

Renal excretion of a substance can be mediated and modified by one or a combination of three processes: filtration, secretion, and reabsorption. Figure 25-2C compares two designs—pure filtration (or secretion) and filtration-reabsorption—and their implications in terms of demands on regulation. The filtration-reabsorption mechanism allows high filtration rates to be achieved, and the coupling with reabsorption prevents loss of valuable fluid and electrolytes. This design also enables economy in transport mechanisms through adaptive targeting of key solutes while allowing the rest to be excreted. However, there is a metabolic price to be paid for this configuration. Consider the excretion of 1 L/day by pure filtration (or secretion). If there is a 5% error (reduction in filtration or secretion), only 0.95 L/day will be excreted—a difference of 50 mL. Compare this to a filtration-reabsorption mechanism wherein 170 L/day is filtered and 169 L/day is reabsorbed, resulting in 1 L/day excretion. A 5% error (reduction) in reabsorption would result in reabsorption of 160 L/day and excretion of 10 L/day, with an absolute