

## Gastrointestinal absorption and secretion

BL BERNE, Robert M. and Matthew N. LEVY, *Principles of Physiology*. St. Louis: The C.V. Mosby Company, 1990.  
 CO COSTANZO, Linda S, *Physiology*, 2nd ed. Baltimore: Williams & Wilkins, 1998.

Nutrient	"Small intestine"			Colon
	Duodenum	Jejunum	Ilium	
(Carbohydrates →) <b>Monosaccharides</b> (glucose, galactose, fructose)  <i>Only D-isomer monosaccharides get absorbed.</i>	The duodenum (and the upper jejunum) have the highest capacity to absorb sugars (BL 399).	<ul style="list-style-type: none"> <li>• The upper jejunum (and the duodenum) have the highest capacity to absorb sugars (BL 399).</li> <li>• Na<sup>+</sup>-dependent cotransport (glucose, galactose).</li> <li>• Facilitated diffusion (fructose).</li> </ul>	<ul style="list-style-type: none"> <li>• Na<sup>+</sup>-dependent cotransport (glucose, galactose).</li> <li>• Facilitated diffusion (fructose).</li> </ul>	
(Proteins →) <b>Amino acids, dipeptides, tripeptides</b>  <i>Only L-isomer amino acids get absorbed.</i>		<ul style="list-style-type: none"> <li>• Na<sup>+</sup>-dependent cotransport (secondary transport, BL 401).</li> <li>• Absorption of dipeptides and tripeptides is faster than that of free amino acids (CO 231).</li> </ul>		

(Lipids →) <b>Fatty acids, monoglycerides, cholesterol</b>	Duodenum and jejunum are most active in fat absorption (BL 412).	<ul style="list-style-type: none"> <li>• Duodenum and jejunum are most active in fat absorption (BL 412).</li> <li>• Micelles form with bile salts in intestinal lumen.</li> <li>• Diffusion of fatty acids, monoglycerides and cholesterol into cell.</li> <li>• Reesterification in cell to triglycerides and phospholipids.</li> <li>• Chylomicrons form in cell (requires β-apoprotein) and are transferred to lymph via the lacteals (BL 413).</li> </ul>		
<b>Fat-soluble vitamins</b> (A, D, E, K)		Fat-soluble vitamins are absorbed in micelles along with bile salts (BL 414).		
<b>Water-soluble vitamins</b> (C, thiamin, niacin, riboflavin, B <sub>6</sub> , folate, biotin, pantothenate)		Na <sup>+</sup> -dependent cotransport.		
<b>Vitamin B<sub>12</sub></b>			Intrinsic factor-Vitamin B <sub>12</sub> complex (CO 234). Following its absorption, Vitamin B <sub>12</sub> appears in the portal blood bound to <i>transcobalamin II</i> (BL 409).	
<b>Bile acids</b>			Na <sup>+</sup> -dependent cotransport; recirculated to liver.	
<b>Na<sup>+</sup></b>		Highest net rate of Na <sup>+</sup> active absorption in the jejunum (BL 403).	Rate of Na <sup>+</sup> active absorption is less than that of the jejunum (BL 403).	Colon actively absorbs Na <sup>+</sup> against a large electrochemical potential difference (BL 403).

<b>Cl<sup>-</sup></b> (Primary ion secreted into the intestinal lumen; CO 233.)		Cl <sup>-</sup> absorbed in large amounts (BL 403).	Some Cl <sup>-</sup> is absorbed (BL 403), partly in exchange for Cl <sup>-</sup> .
<b>HCO<sub>3</sub><sup>-</sup></b> (Chief anion secreted)		HCO <sub>3</sub> <sup>-</sup> absorbed in large amounts (BL 403).	HCO <sub>3</sub> <sup>-</sup> <b>secreted</b> (BL 403).
<b>K<sup>+</sup></b>		Absorbed by passive diffusion via a cellular route (CO 233).	K <sup>+</sup> usually <b>secreted</b> by the colon (BL 404). Secretion is stimulated by aldosterone (CO 233).
<b>Ca<sup>2+</sup></b>		<ul style="list-style-type: none"> <li>• Vitamin D-dependent Ca<sup>2+</sup>-binding protein (<i>calbindin</i>) in enterocytic cytosol (BL 406) helps transport Ca<sup>2+</sup> across apical cell membrane.</li> <li>• Calcium is transported across the basolateral cell membrane by a Na<sup>+</sup>/Ca<sup>2+</sup>-ATPase (BL 406).</li> </ul>	
<b>Fe<sup>2+</sup></b>		<ul style="list-style-type: none"> <li>• Absorbed as either <i>heme iron</i> or as <i>free Fe<sup>2+</sup></i> (CO 234).</li> <li>• In enterocytes, heme iron is degraded, releasing free Fe<sup>2+</sup>, which gets bound to <i>apoferritin</i> and transported into blood.</li> <li>• Free Fe<sup>2+</sup> circulates in blood bound to <i>transferrin</i>.</li> </ul>	
<b>Mg<sup>2+</sup></b>		Magnesium is absorbed along the entire length of the small intestine (BL 408).	
<b>PO<sub>4</sub><sup>3-</sup></b>		Phosphate is absorbed all along the small intestine. Some may be absorbed by active transport (BL 408).	
<b>Cu<sup>2+</sup></b>		Copper is absorbed in the jejunum (BL 408).	

**H<sub>2</sub>O**

(Water absorption is always secondary to solute absorption; CO 233.)

The duodenum is very permeable to water, but since both large influx and efflux of water occur, there is very little net absorption of water (BL 402).

Most water absorption occurs in the jejunum (BL 403).

Considerable water absorption occurs in the ileum, but not as much as in the jejunum (BL 403).

Net water absorption in the colon is relatively small ( $\approx 400$  ml/day), however, the colon can absorb water against a larger osmotic pressure difference than the rest of the GI tract (BL 403).