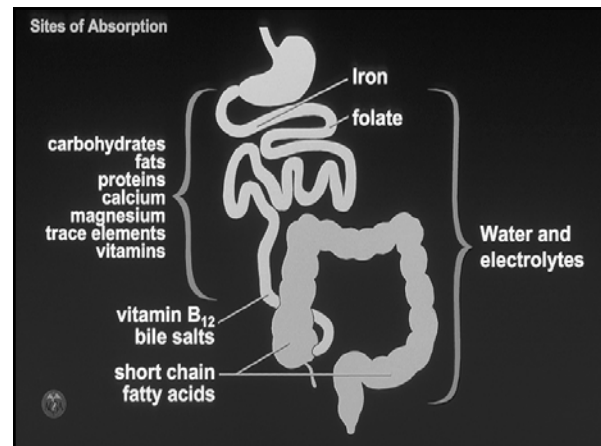


Absorption and Malabsorption

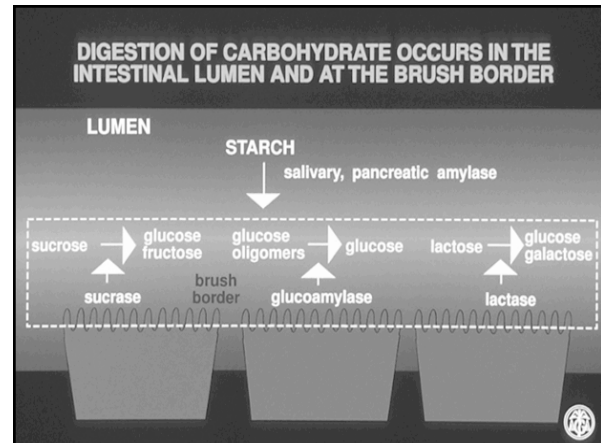
Richard M. Rosenberg, M.D.
Division of Digestive and Liver Disease
Department of Medicine
Columbia University Medical Center



The intestine has a very large surface area for absorption

Type of Surface	Amplification Factor	Surface Area (cm ²)
Mucosal cylinder	1	3,300
Fold of Kerkring	3	10,000
Villi	10	100,000
Microvilli	20	2,000,000

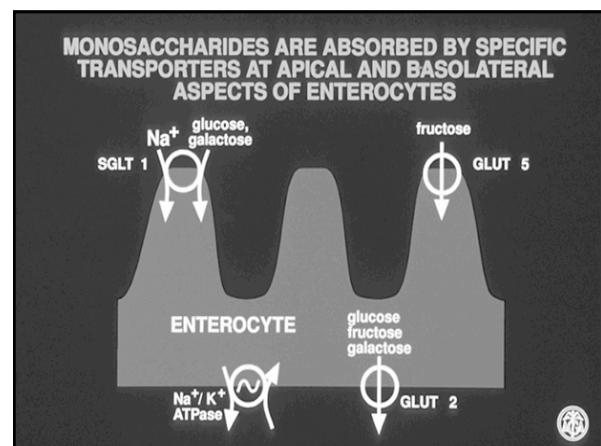
Total surface area = 200 m²
Double Tennis Court = 175 m²

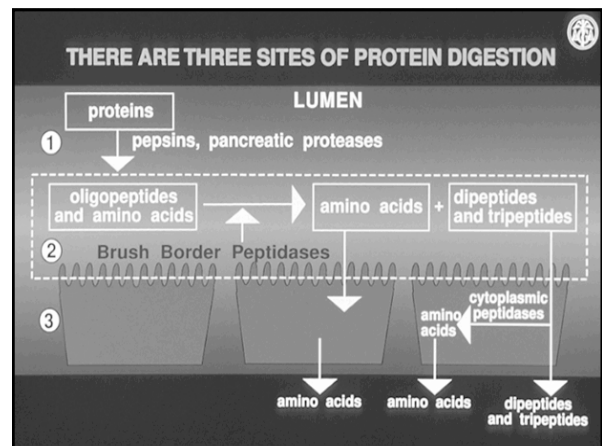
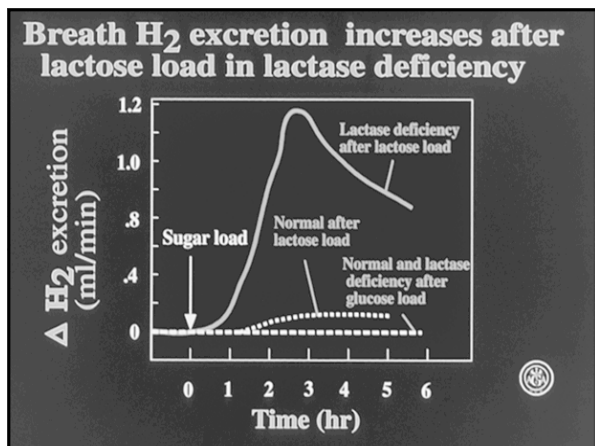
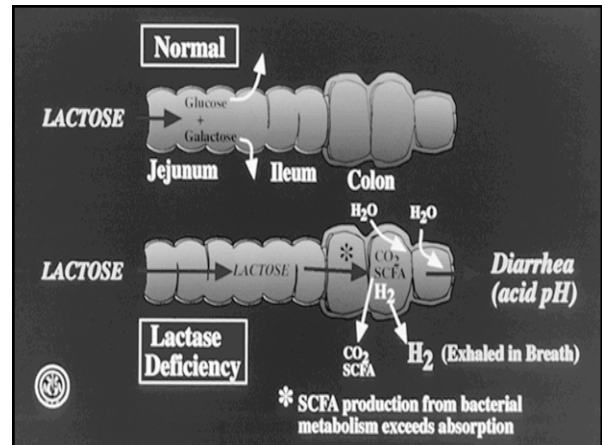
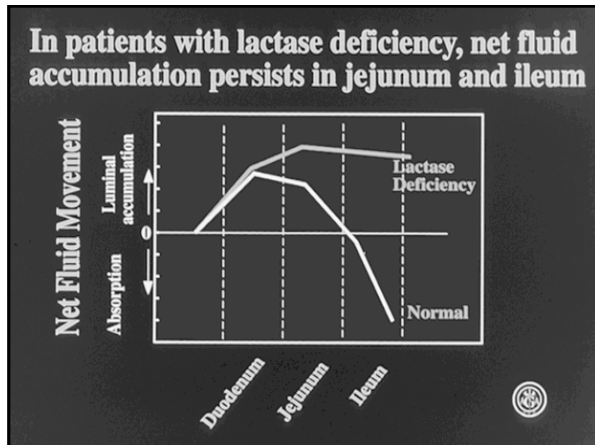
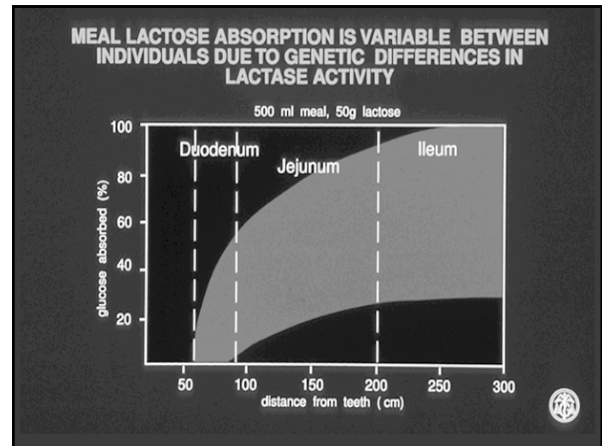
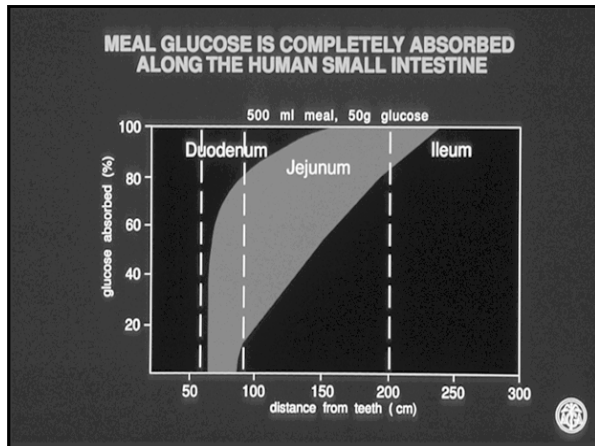


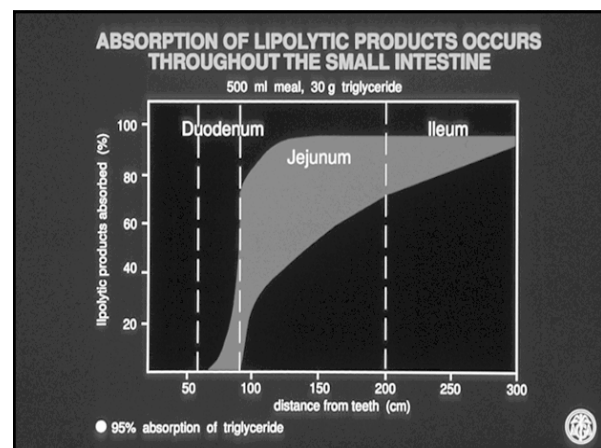
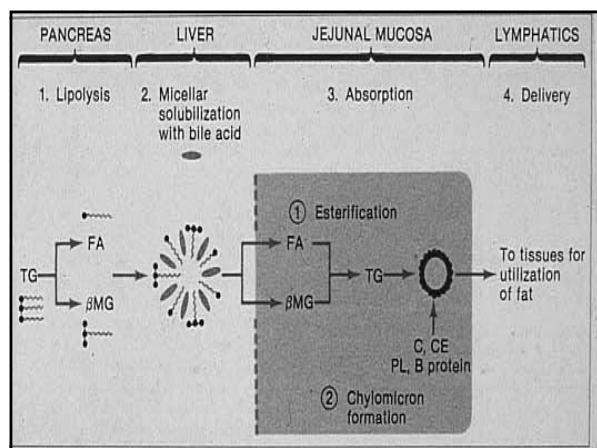
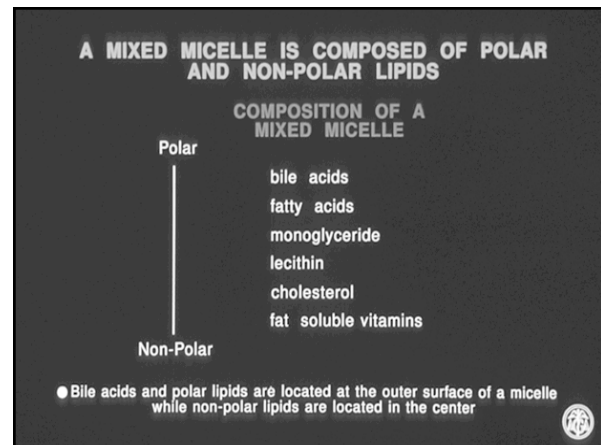
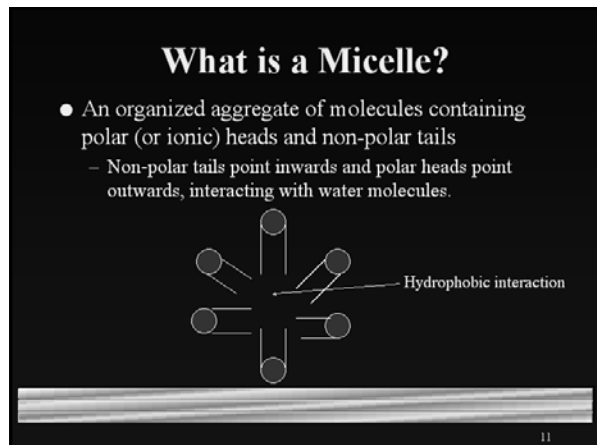
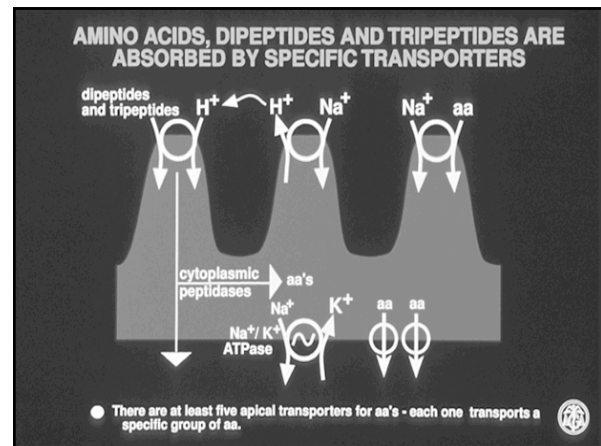
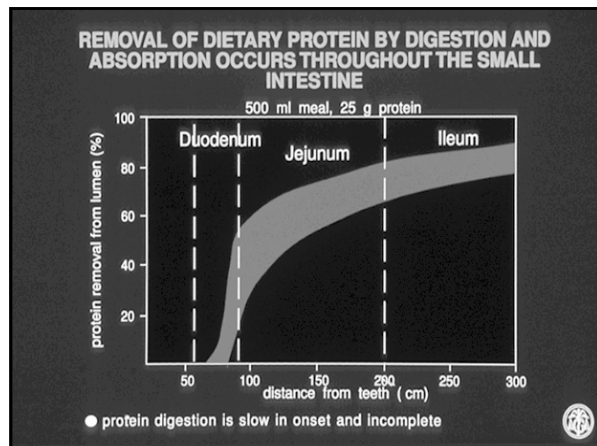
Cell Model

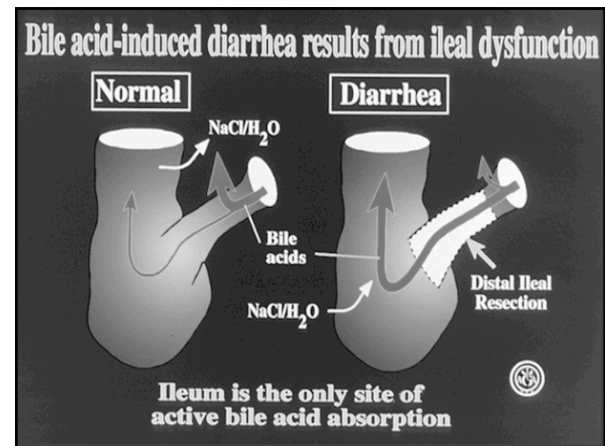
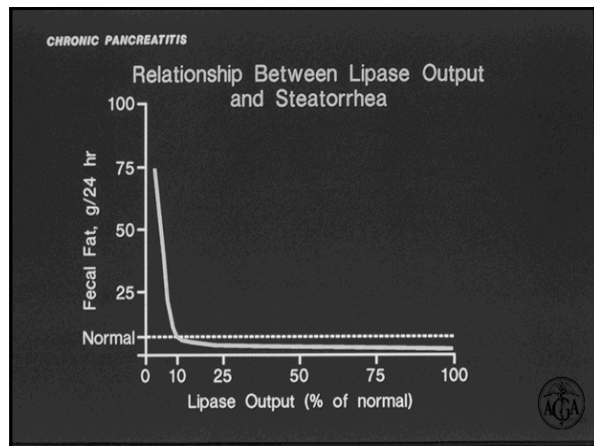
Na⁺/K⁺ ATPase on basal-lateral membrane pumps out 3 Na⁺ and pumps in 2 K⁺ maintaining an electrochemical Na⁺ gradient

SGLT1 – Sodium/Glucose co-transporter on apical membrane makes use of this gradient









Limited Ileal Resection (<100cm)

- Increased Bile Salt production by liver able to compensate for losses
- Fat absorption not compromised
- Increased bile salt delivery to colon produces secretory diarrhea, responds to cholestyramine
- Antimotility drugs may counter rapid transit
- B12 absorption may be compromised

Long-term Management

Limited Ileal Resection
<100cm resected

Standard	As needed
• Regular diet	• Cholestyramine
• Multivitamin	• Antimotility agent
	Monitor
	• Bone density
	• Fat-soluble vitamins
	• Vitamin B ₁₂
	• Urine oxalate

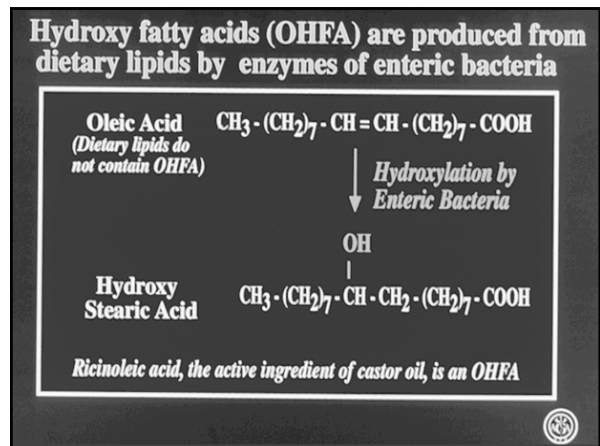
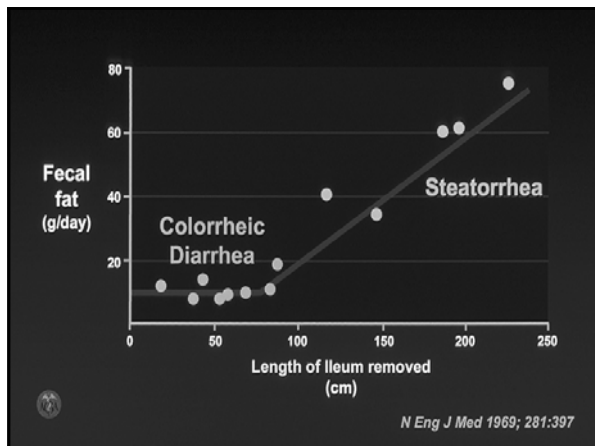
Extensive ileal resection (>100cm)

- Liver can't compensate → Bile Acid pool reduced → Impaired micelle formation → Fatty Acids reach colon → Hydroxylation of FA by colonic bacteria → secretory diarrhea and steatorrhea.
- FA bind Ca⁺⁺ resulting in free oxylate, absorbed by colon → hyperoxaluria → oxylate renal stones
- B12 supplement always necessary
- High Ca⁺⁺, low fat, low oxylate diet helpful
- Cholestyramine may worsen diarrhea

Long-term Management

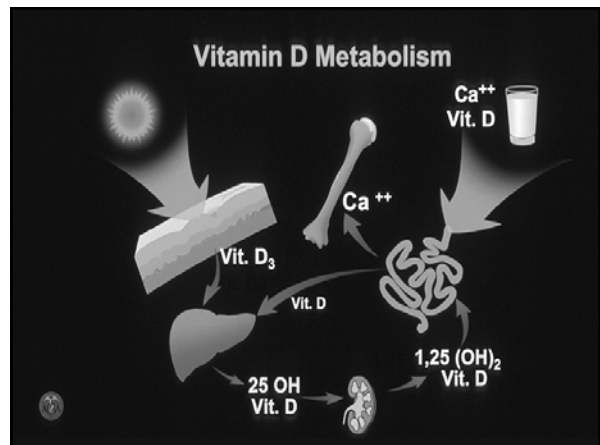
Ileal Resection
>100cm resected

Standard	As needed
• Diet low fat low oxalate	• ? cholestyramine
• Vitamin B ₁₂	Monitor
• Multivitamin and mineral	• Bone density
• Calcium	• Fat-soluble vitamins
• Antimotility agent	• Urine oxalate



Several features help distinguish bile acid- from fatty acid-induced diarrhea

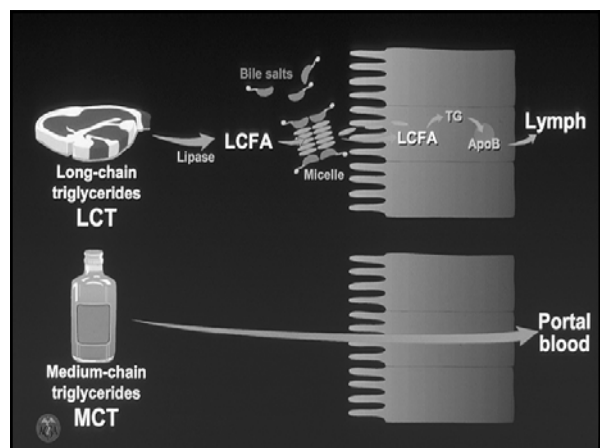
Characteristic	Bile Acid	Fatty Acid
1. Length of resection	small	large
2. Fecal BA output	↑	↑↑
3. Fecal BA loss compensated by hepatic BA synthesis	yes	no
4. BA pool size	normal	↓
5. Duodenal [BA]	normal	↓
6. Steatorrhea	normal or mild	>20 g/24 hrs
7. Responds to low fat diet	no	yes
8. Responds to cholestyramine	yes	no

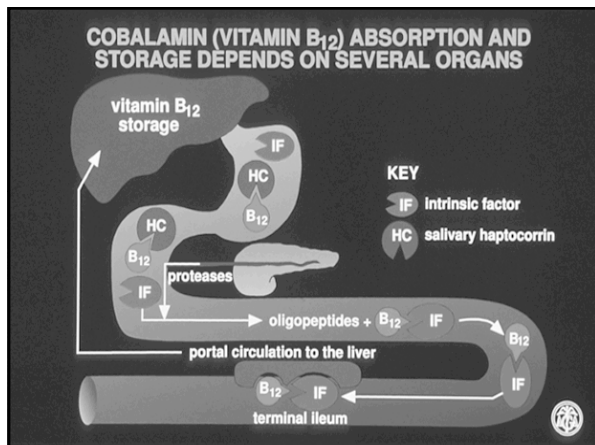
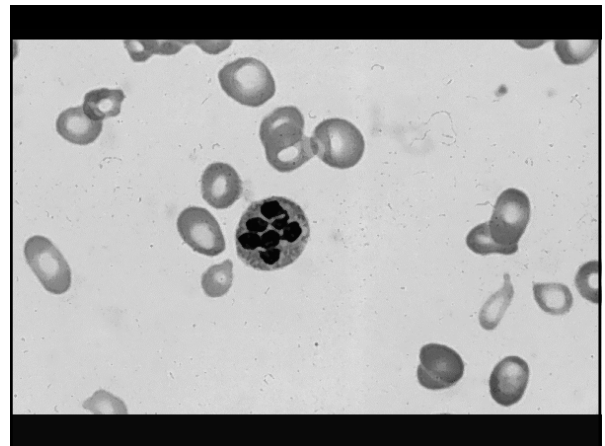
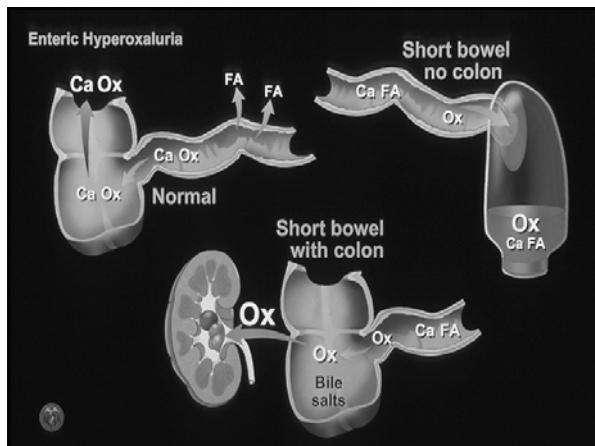


CHRONIC PANCREATITIS

Treatment of Steatorrhea

- Ingest potent enzymes
- Protect enzymes
reduce H⁺ (H-2 blocker) or ingest enteric-coated
- Decrease dietary fat





Dietary Cobalamin

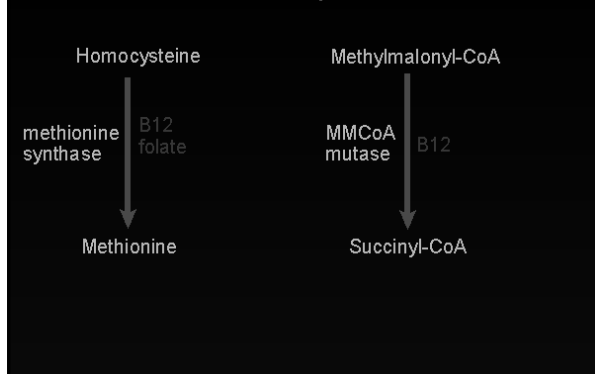
“Everything that walks, swims, or flies contains Vitamin B12. Nothing that grows from the ground contains Vitamin B12.”

Decreased absorption in elderly.

Daily requirement from diet only 1mcg/d

Deficiency can be seen in strict vegans

Biochemistry of B12



Causes of B12 Deficiency

Inadequate Intake

Vegans

Inadequate liberation from food

Food Cobalamin Malabsorption

Lack of Intrinsic Factor

Pernicious Anemia, Gastrectomy

Impaired proteolytic degradation of R-B12 complex

Pancreatic Insufficiency, ZE Syndrome

Causes of B12 Deficiency

Infection (competition for luminal B12)

Bacterial overgrowth

strictures

blind loop

motility disorders

Diphyllobothrium latum

Causes of B12 Deficiency

Absent or non-functioning Ileal mucosa

Crohn's Disease, Tropical Sprue,
Lymphoma, TB, Ileal Resection

Abnormal translocation across enterocyte

Juvenile PA, Transcobalamin II Deficiency,
Imerslund-Grasbeck syndrome

Drugs

Colchicine, Biguanide, Nitrous Oxide, PAS

SCHILLING TEST AS A MEASUREMENT OF VIT B12 ABSORPTION					
Stage	Food-Cobalamin Malabsorption	Pernicious Anemia or Gastrectomy	Pancreatic Insufficiency	Bacterial Overgrowth	Ileal Resection or Disease
1) Vit B12	Normal	Decreased	Decreased	Decreased	Decreased
2) Vit B12 + Intrinsic Factor		Normal	Decreased	Decreased	Decreased
3) Vit B12 + Pancreatic Enzymes			Normal	Decreased	Decreased
4) Abs followed by Vit B12				Normal	Decreased

Vitamin and Mineral Deficiencies	
Manifestations	
Vitamin B ₁₂ / Folate Iron	anemia, glossitis, cheilitis, angular stomatitis, diarrhea*, paresthesias*, ataxia* *Vitamin B ₁₂ only
Vitamin D Calcium / magnesium	osteoporesis, osteomalacia, paresthesias, tetany
Zinc	anorexia, diarrhea, rash, alopecia
Vitamin A	night blindness, dry eyes, hyperkeratosis, diarrhea
Vitamin K	ecchymoses, bleeding
Vitamin E	paresthesias, ataxia, retinopathy

It's 9:55. I'm so outta here!



Good Luck on Final, Boards, and Wards.