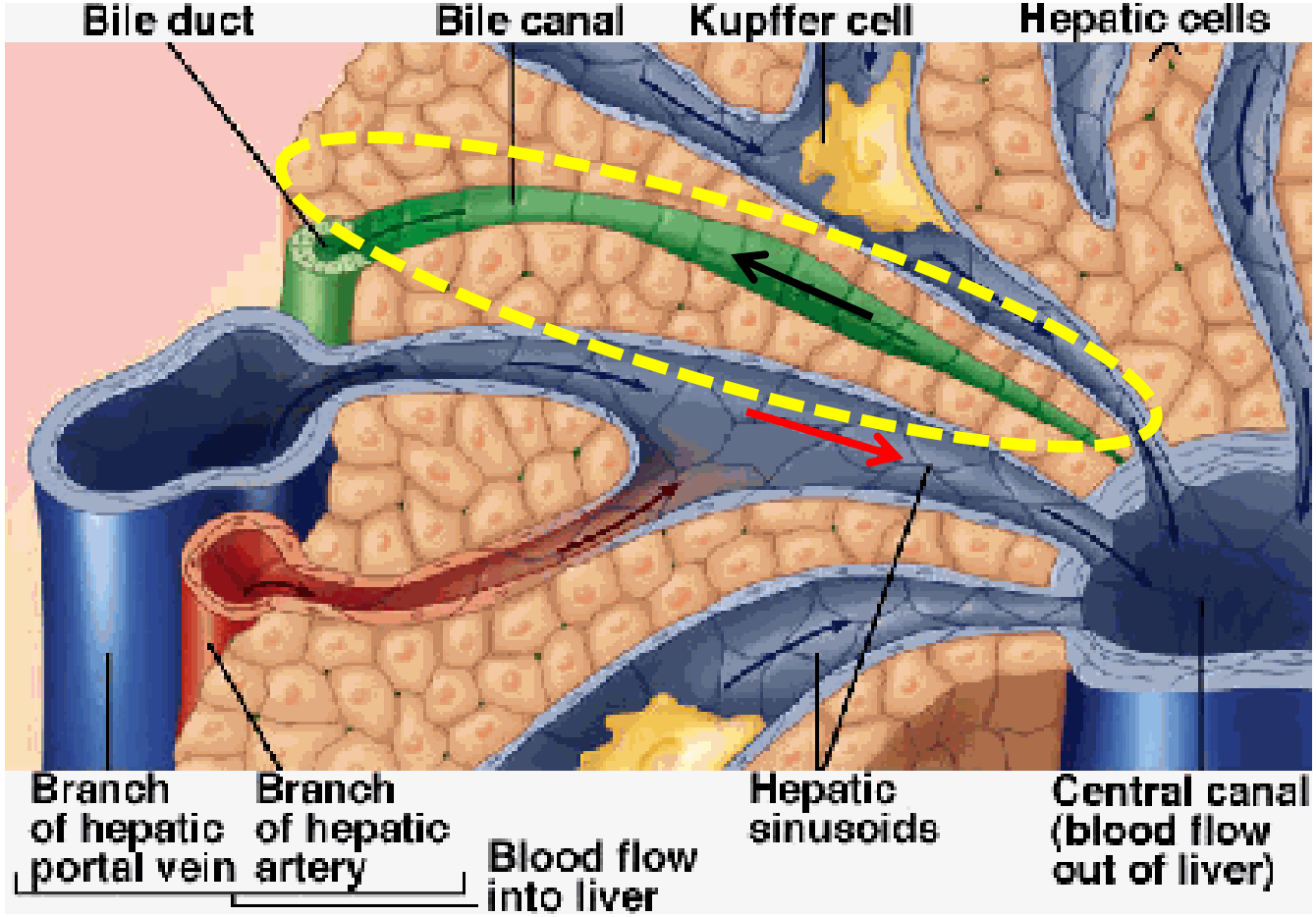
Start Module 2:

Physiology: Bile, Bilirubin

Liver and the Lab

Bile Physiology – WYNTKFTB
(Intro to Pathology)

- Applied Anatomy
- Components
- Function
- Synthesis
- Enterohepatic circulation
- Imbalance of components (i.e. lithogenesis)
- Marker of biliary injury



the Bile

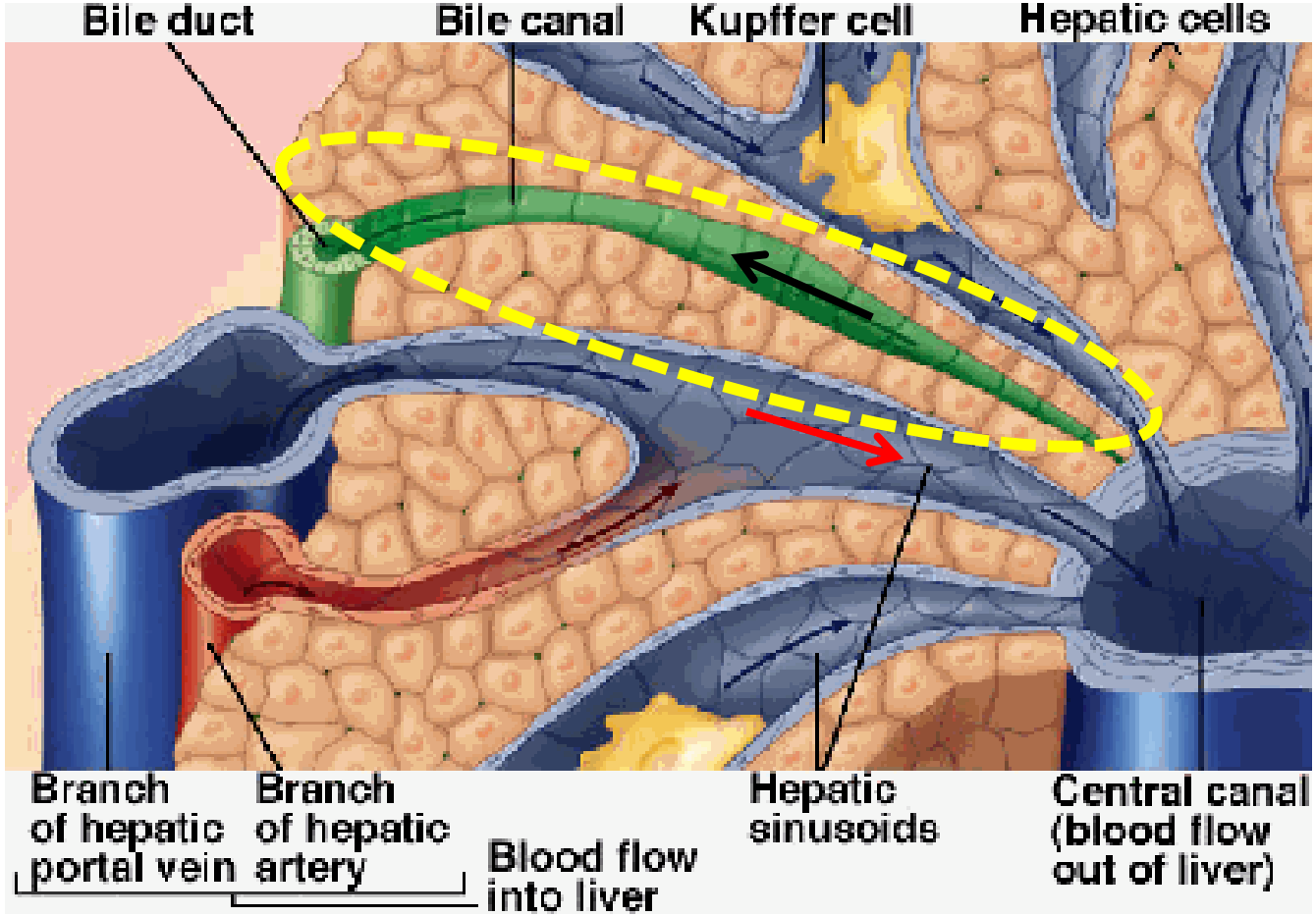
Key Players:

Cannicular Markers:

Components:

Function:

Dysfunction:

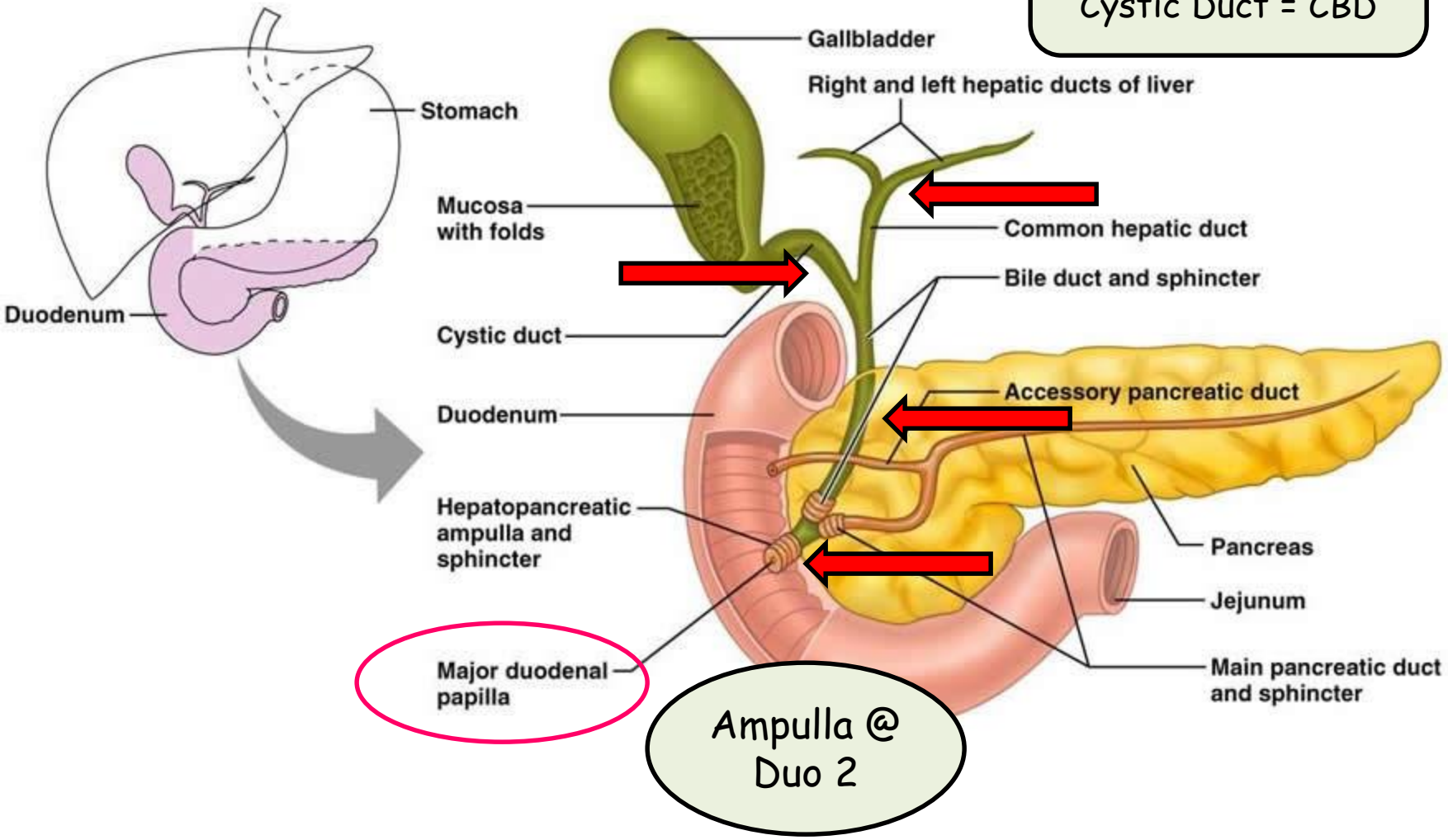


the Bile

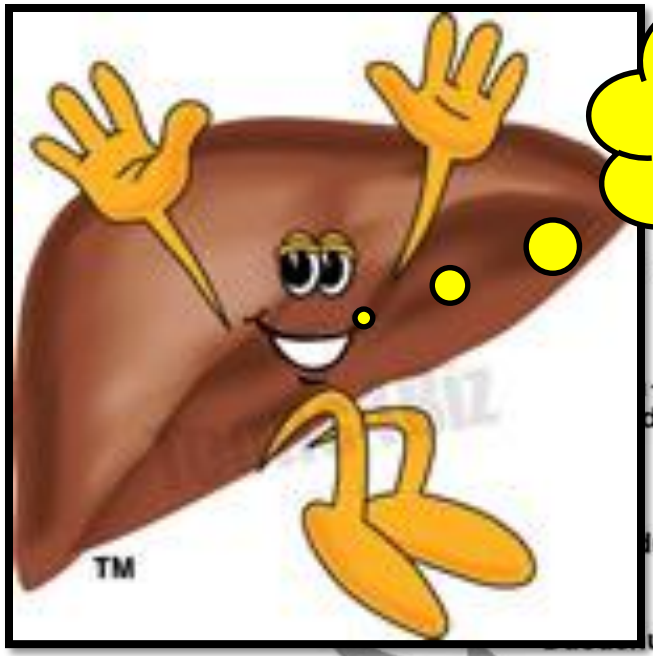
Key Players:

Cannicular Markers: Alk Φ, γ-GT
Components: BS, Cholesterol, Bilirubin
Function: Fat Digestion, Excretion
Dysfunction: Obstruction, Destruction

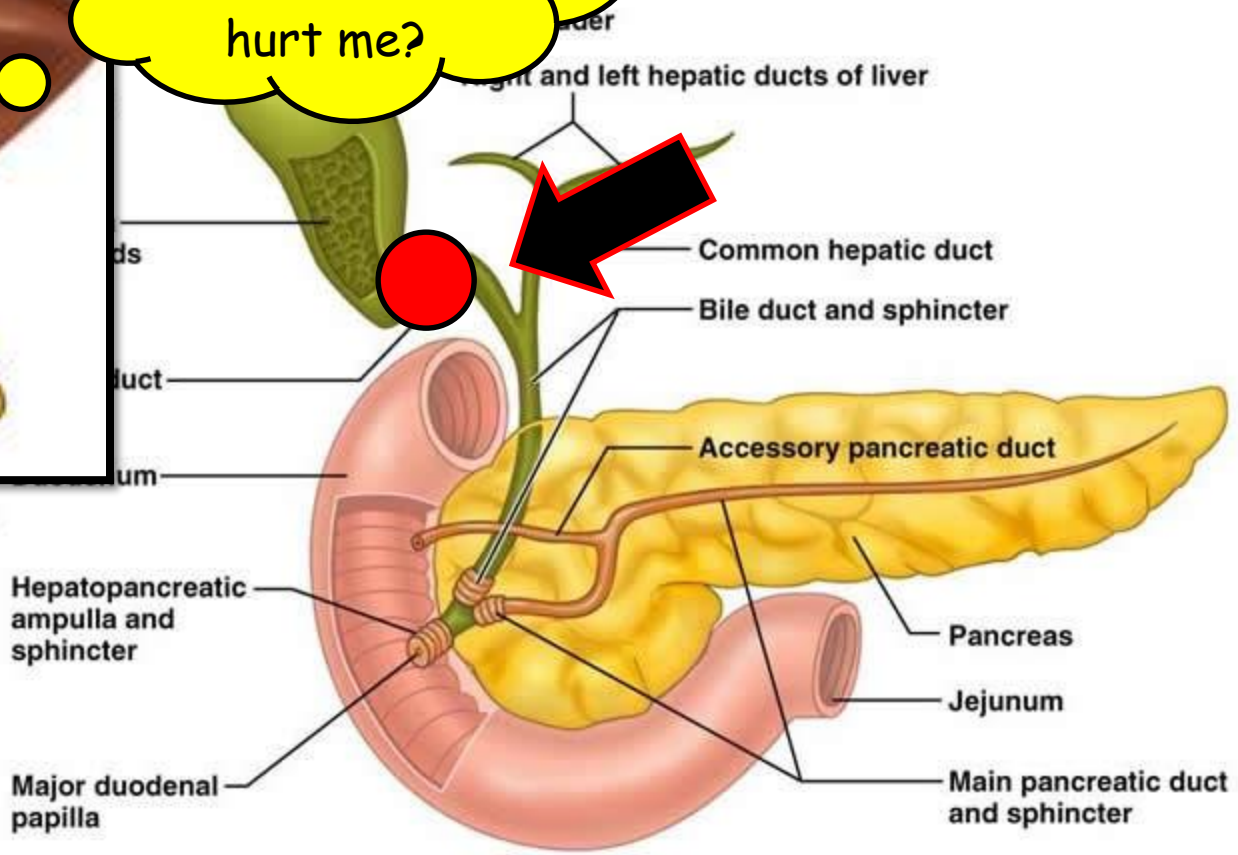
Biliary Anatomy:
Hepatic Ducts +
Cystic Duct = CBD



Ampulla @
Duo 2



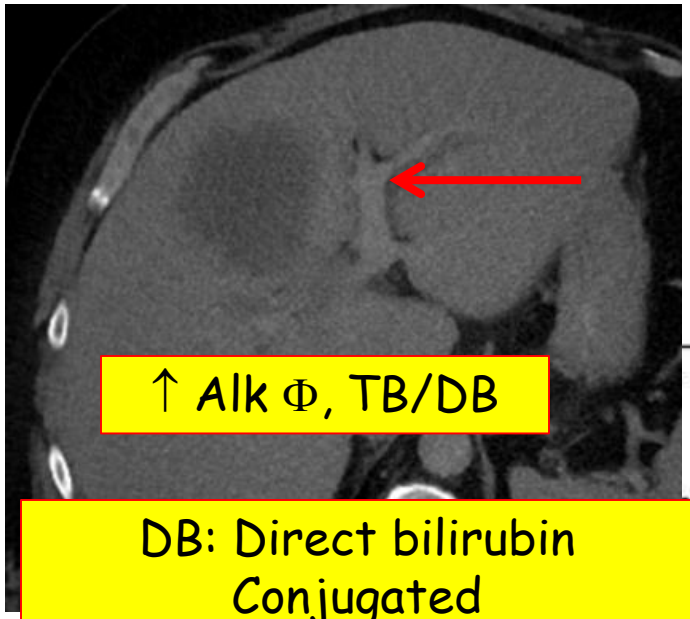
Can a cystic duct stone or obstruction hurt me?



A. Yes

B. No

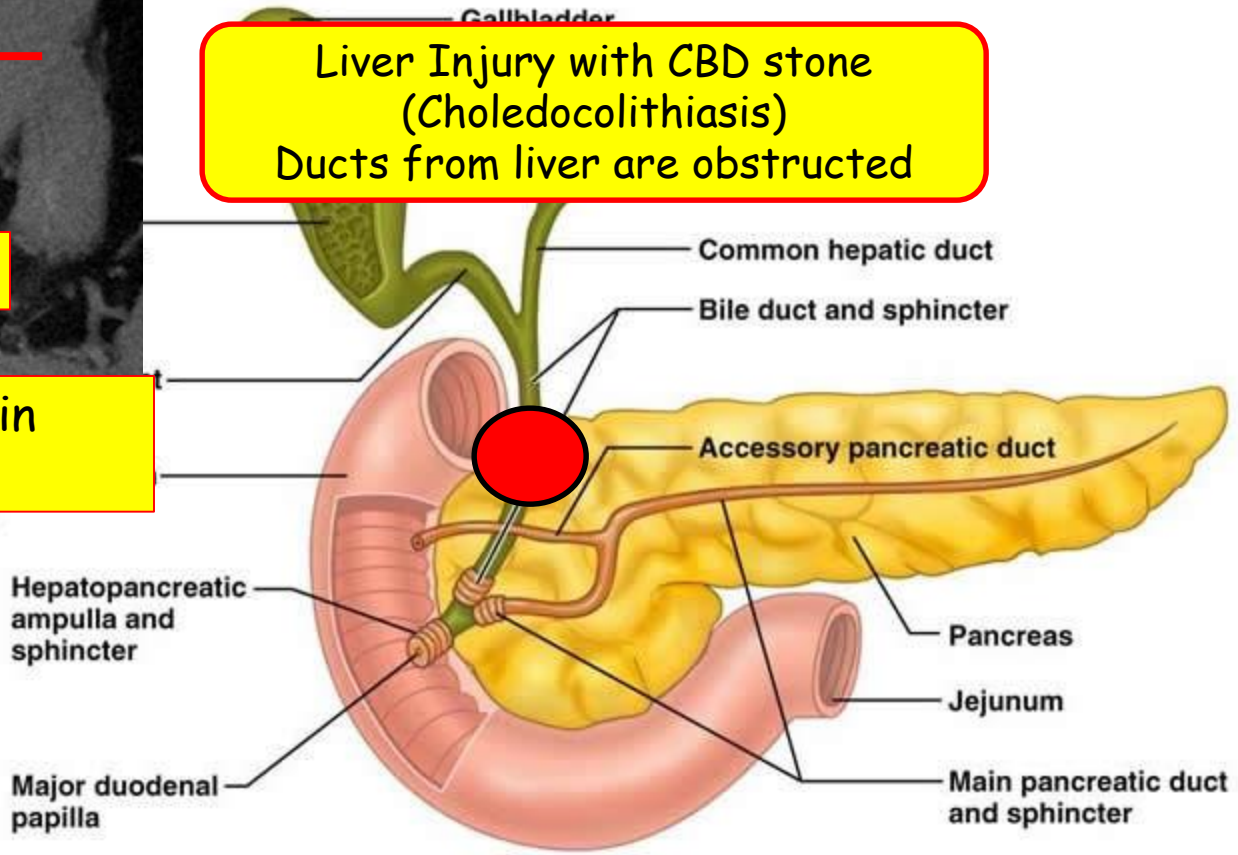
Obstructive Jaundice

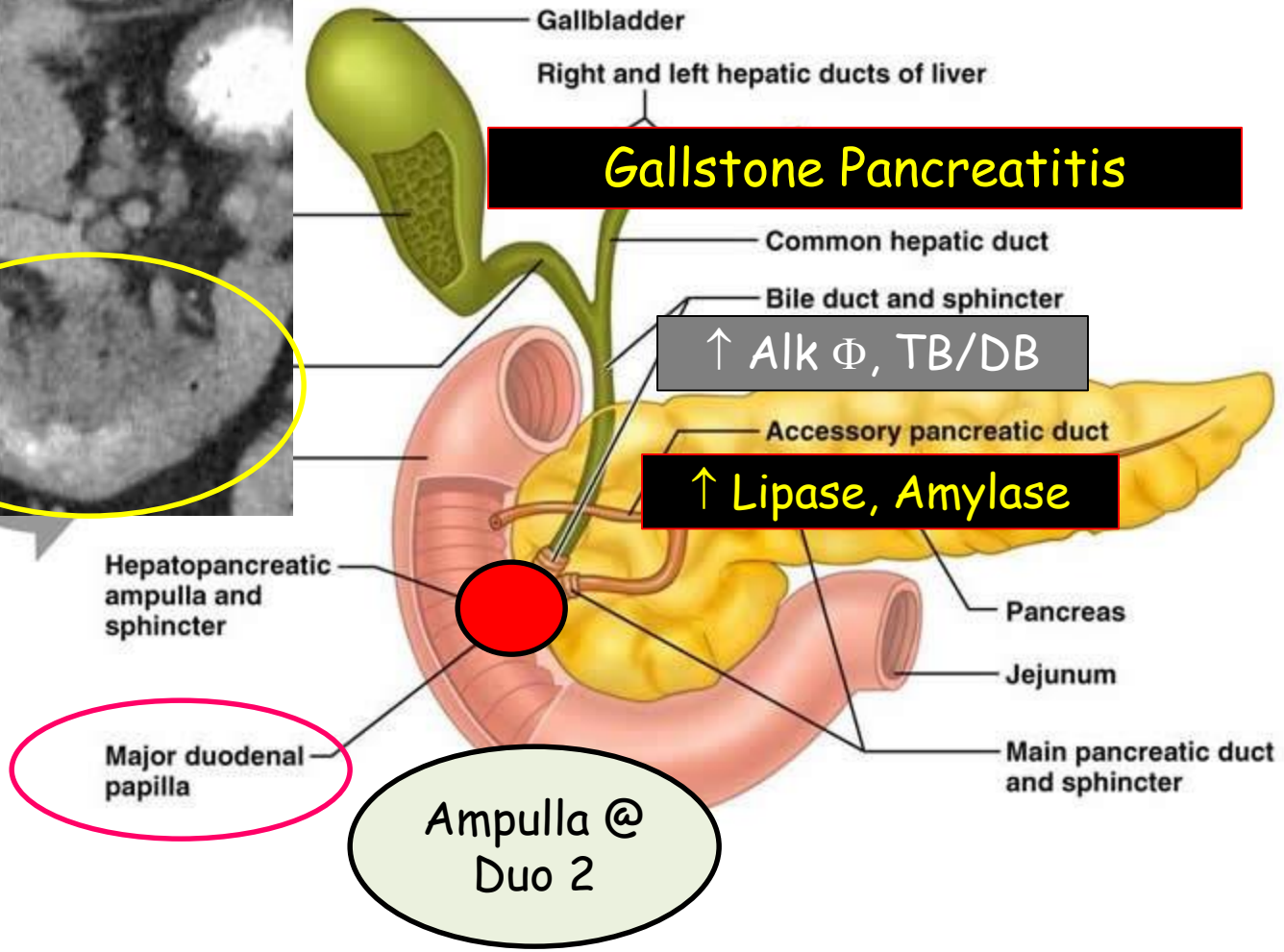


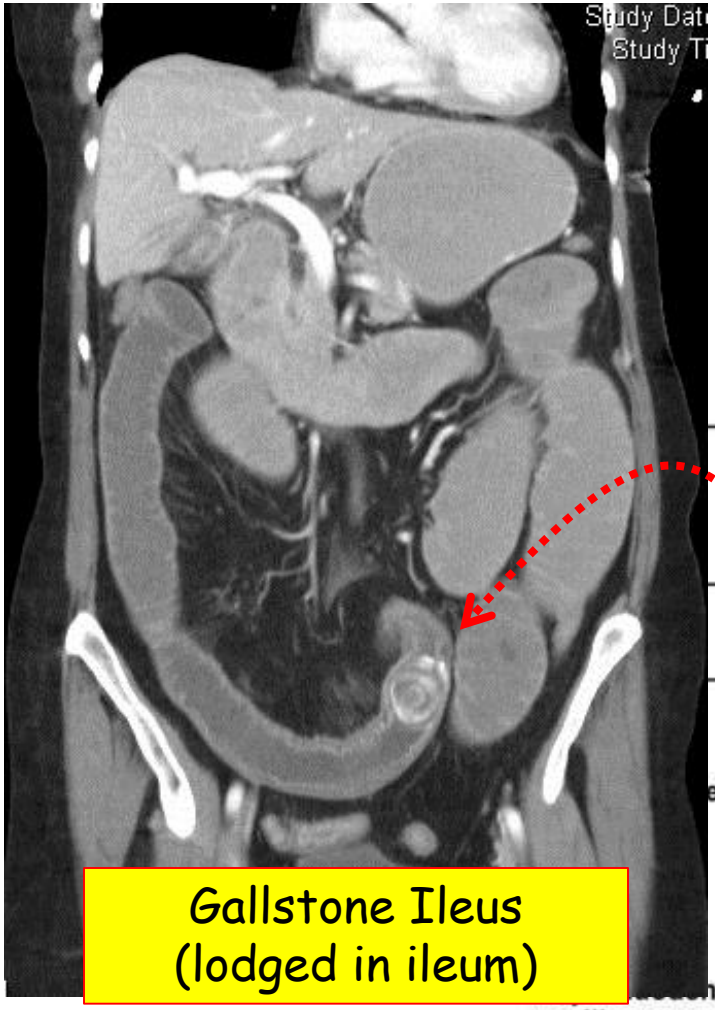
↑ Alk Φ, TB/DB

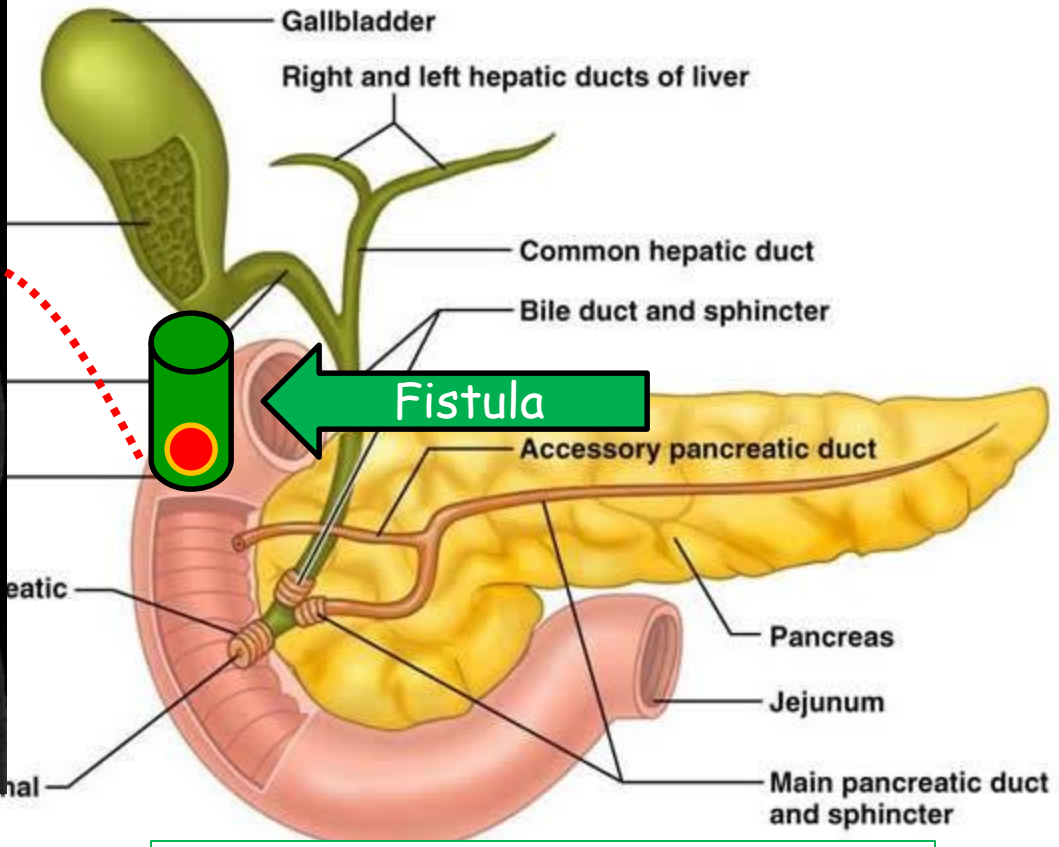
DB: Direct bilirubin
Conjugated

Liver Injury with CBD stone
(Choledocolithiasis)
Ducts from liver are obstructed

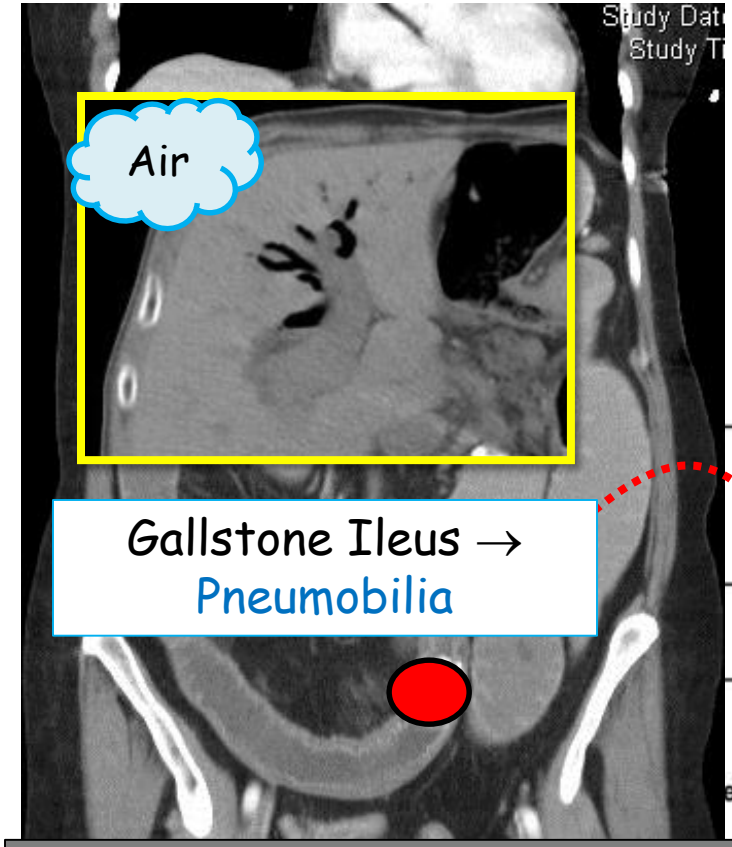


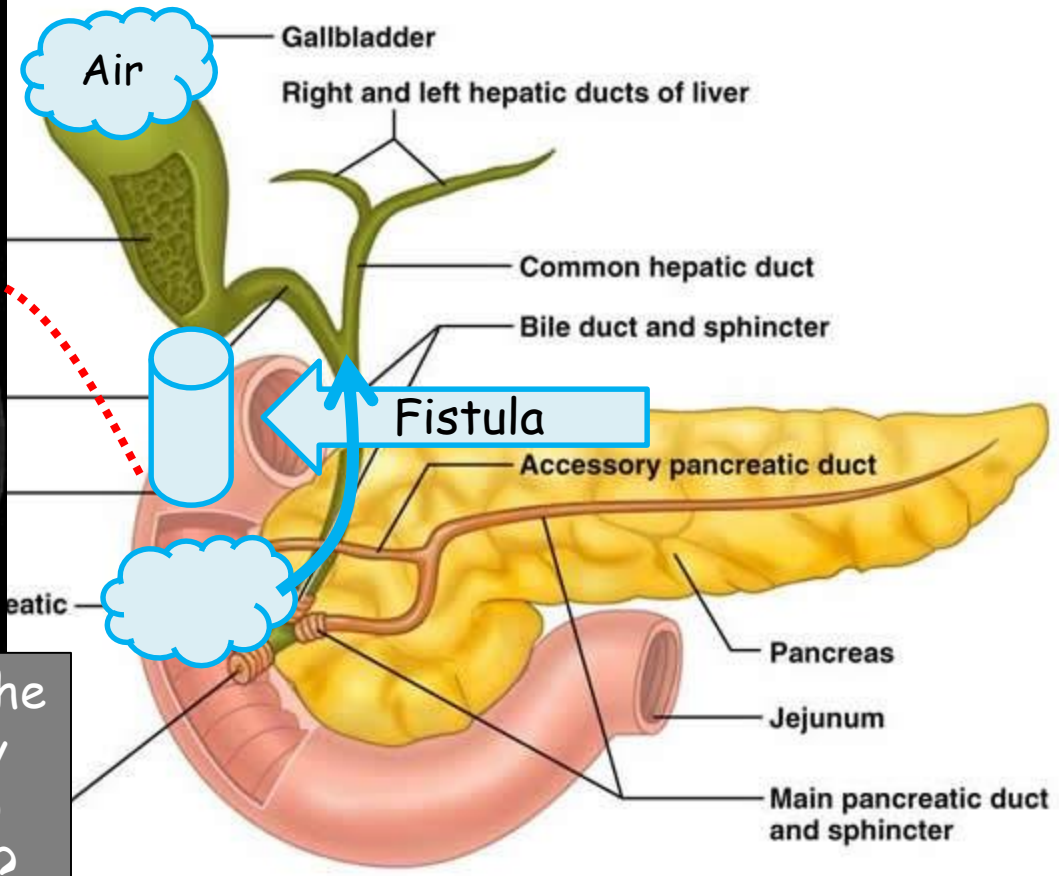

Gallbladder
Right and left hepatic ducts of liver
Gallstone Pancreatitis
Common hepatic duct
Bile duct and sphincter
↑ Alk Φ, TB/DB
Accessory pancreatic duct
↑ Lipase, Amylase
Hepatopancreatic ampulla and sphincter
Pancreas
Jejunum
Major duodenal papilla
Main pancreatic duct and sphincter
Ampulla @ Duo 2





If there is a fistula between the air-filled intestine and biliary ducts, what do you expect to find in the hepatobiliary tree?





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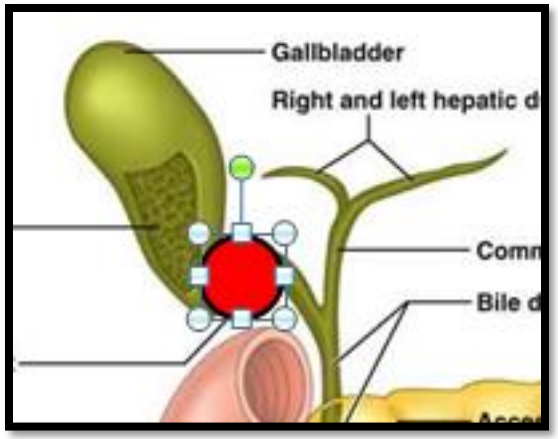
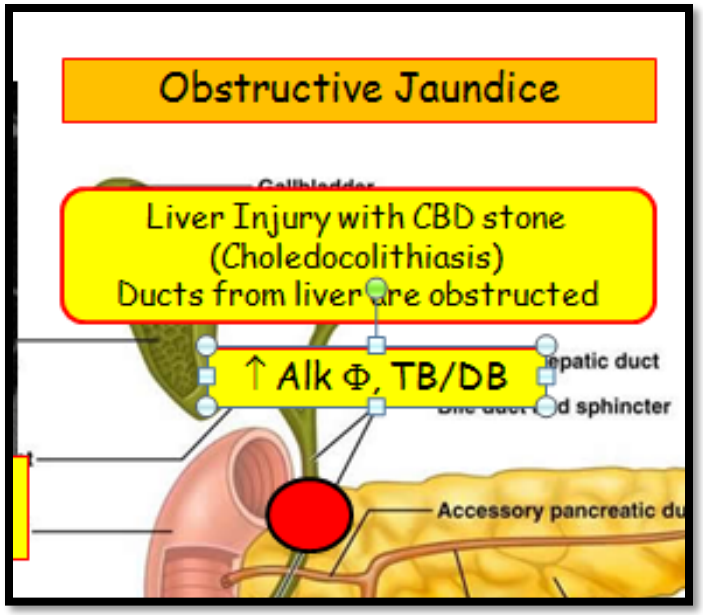
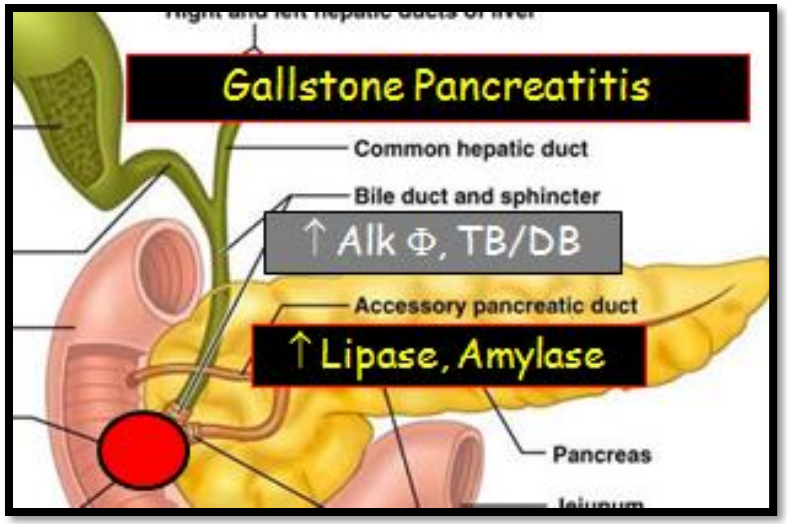


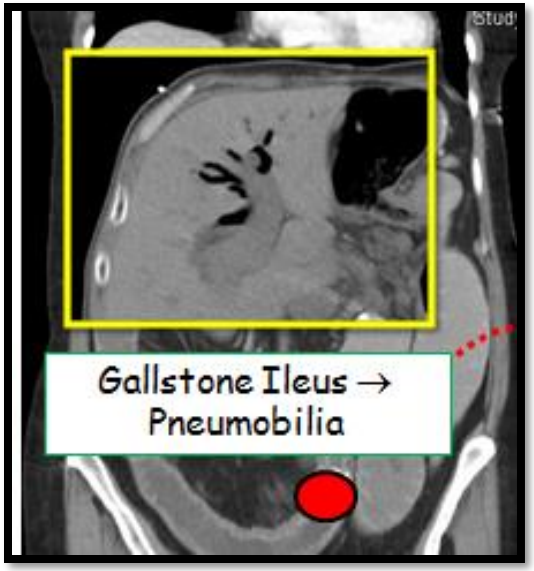
Cystic Duct



Common Bile Duct

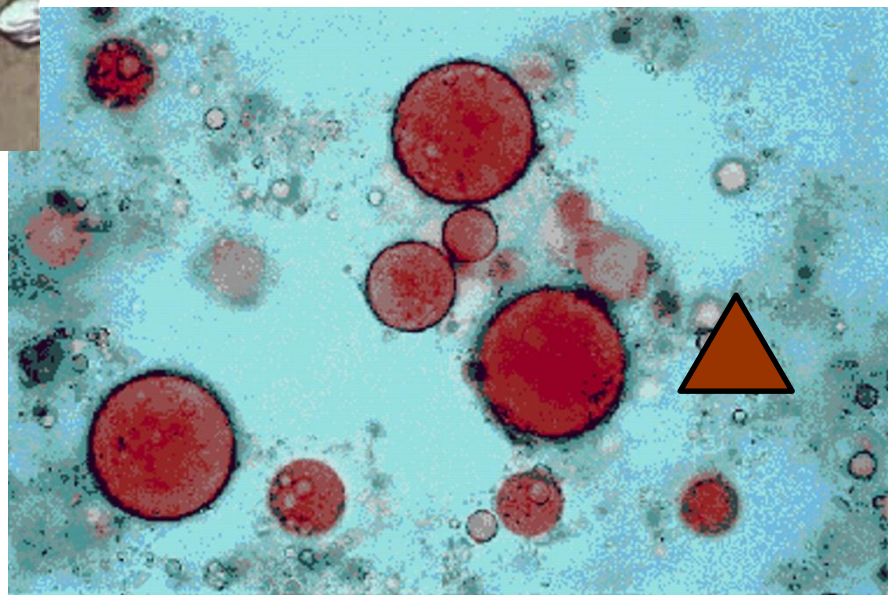


Obstruction, Ampulla

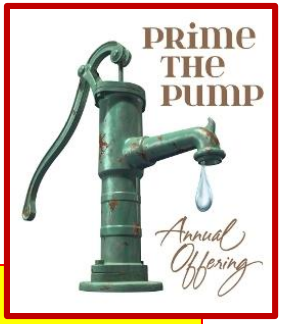


Fistula b/w GB & intestine with obstruction at ileocecal vv

Bile Trivia for USMLE?



Bile Trivia for USMLE?



- What is the principle mode of ridding the body of cholesterol?
- What is the primary building block of bile acid synthesis?
- What is the difference between bile acid and bile salt?
- What are the main constituents of bile?

Not So Trivial Bile Facts for USMLE?

- What is the principle mode of ridding the body of cholesterol?
  - Excreted in bile (bile acid/salts) → (think cholestyramine)
  - Secreted in bile

Cholestyramine:
MOA: Binds bile salts → ↑ LDL receptor
AE: ↑ Triglycerides

Not So Trivial Bile Facts for USMLE?

- What is the principle mode of ridding the body of cholesterol?
  - Excreted in bile (bile acid/salts) → (think cholestyramine)
  - Secreted in bile
- What is the primary building block of bile acid synthesis?
  - Cholesterol → cholic and chenodeoxycholic acids

7α-hydroxylase. → (think fibrates and stones)

Fibrates:

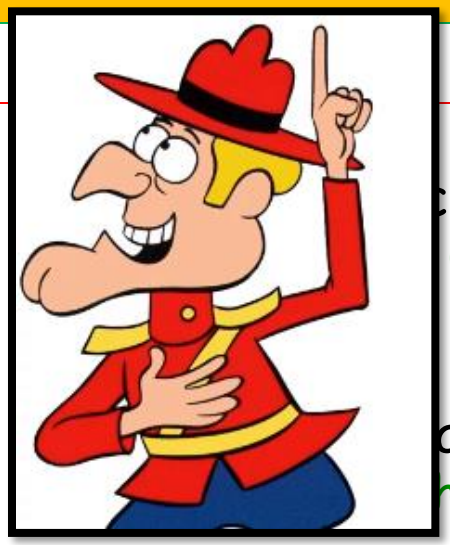
MOA: ↑ PPAR → ↑ LPL

AE: interfere w/ 7α-OHase → ↑ cholesterol → stones

Not So Trivial Bile Facts for USMLE?

- What is the principle mode of ridding the body of cholesterol?
  - Excreted in bile (bile acid/salts)
  - Secreted in bile
- What is the primary building block of bile acid synthesis?
  - Cholesterol → cholic and chenodeoxycholic acids
- What is the difference between bile acid and bile salt?
  - Conjugation.
  - Adding glycine/taurine to bile acids renders them bile salts and therefore water soluble.
- What are the main constituents of bile?
  - Bile salts, phospholipids (PPL; hydrophilic), cholesterol (stones)
  - Bilirubin added for color ; Water and Ions added for flavor.

Not So Trivial Bile Facts for USMLE?



- ciple mode of ridding the body of cholesterol?
  (bile acid/salts)

Delicate balance

- ary building block of bile acid synthesis?
  holic and che deoxycholic acids

Bile salts
PPL

- W ference h bile acid and bile salt?
  -
  - Adding glycine/taurin nders t l
    therefore water soluble.

Cholesterol

- What are the main constituents of bile?
  - Bile salts, phospholipids (PPL; hydrophilic), ch
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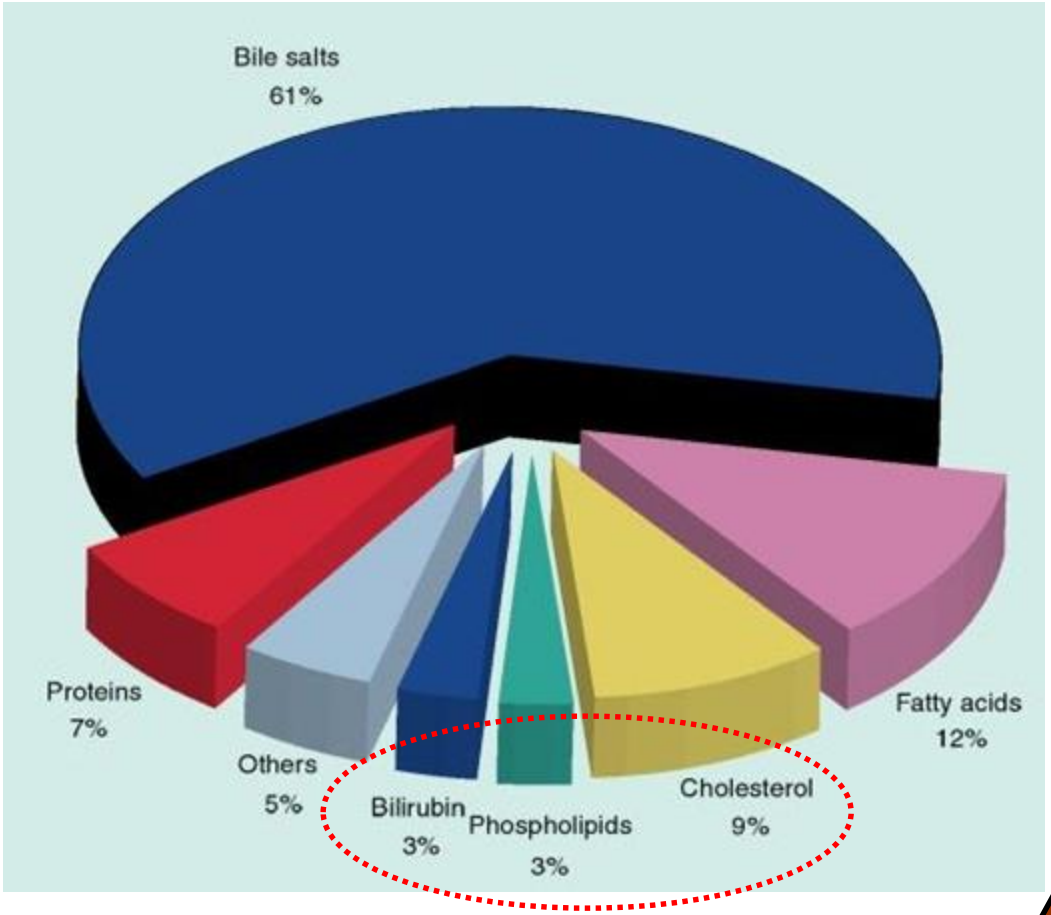
Bile

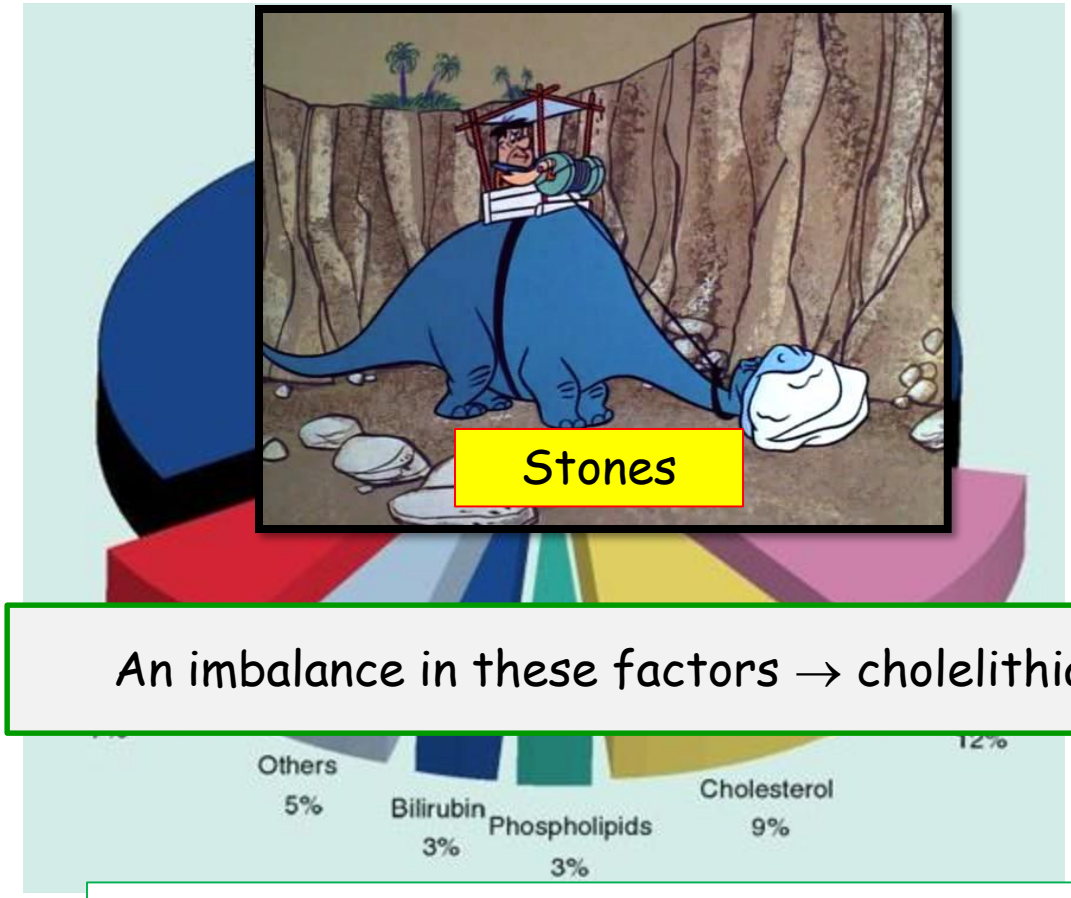


Bile Salts
(PPL)

Cholesterol

Bilirubin

Delicate balance



↓ Bile Salts

↑ Cholesterol

An imbalance in these factors → cholelithiasis

↑ Bilirubin

They are really interested in cause/consequence of this imbalance.

Decrease:
Liver failure
Disease of ducts (PBC, CF)
Failure of enterohepatic circulation

↓ Bile Salts

Increase:
Pregnancy
Obesity

↑ Cholesterol

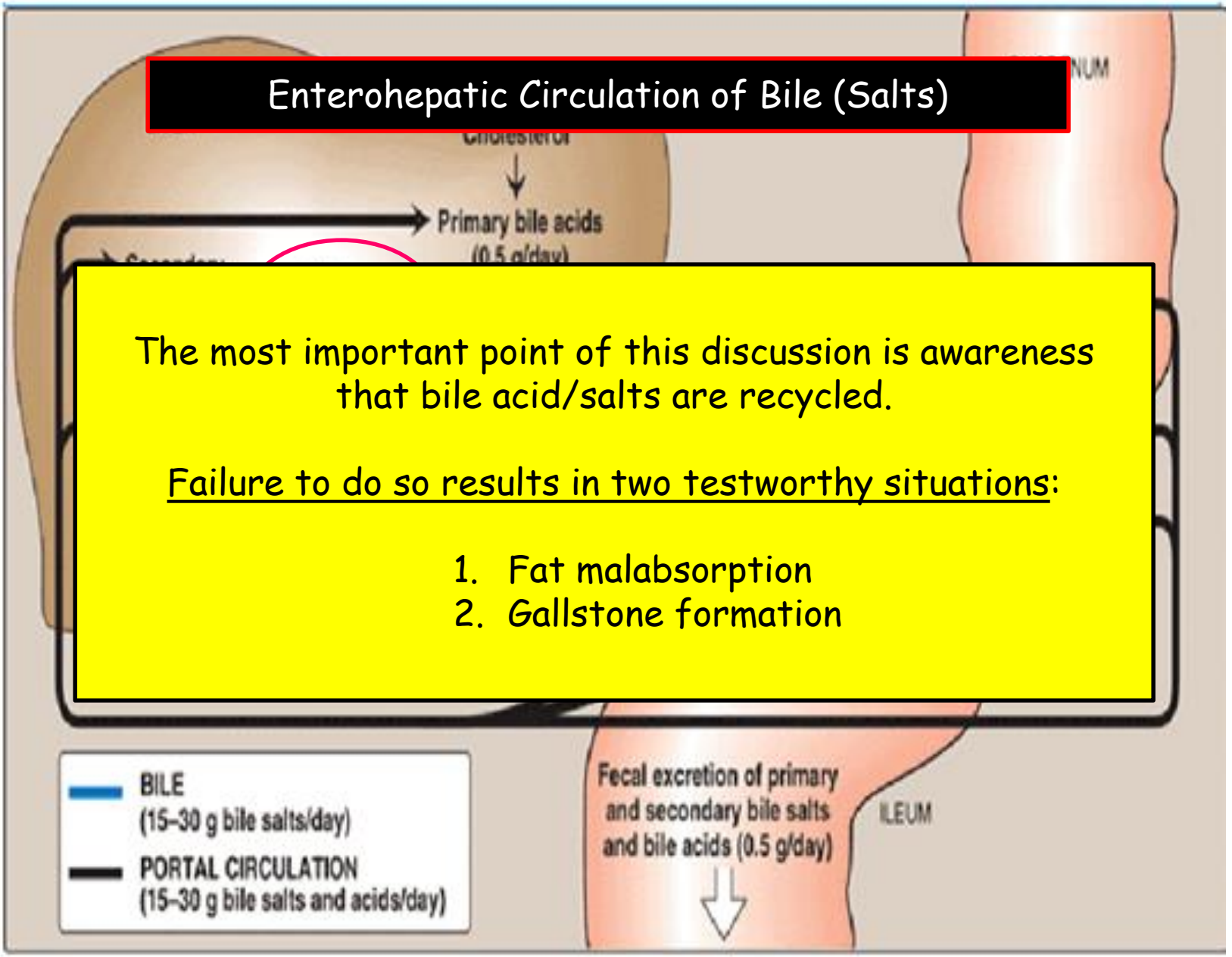
Bili

Increase:
Hemolysis

Bili

↑ Bilirubin

Enterohepatic Circulation of Bile (Salts)

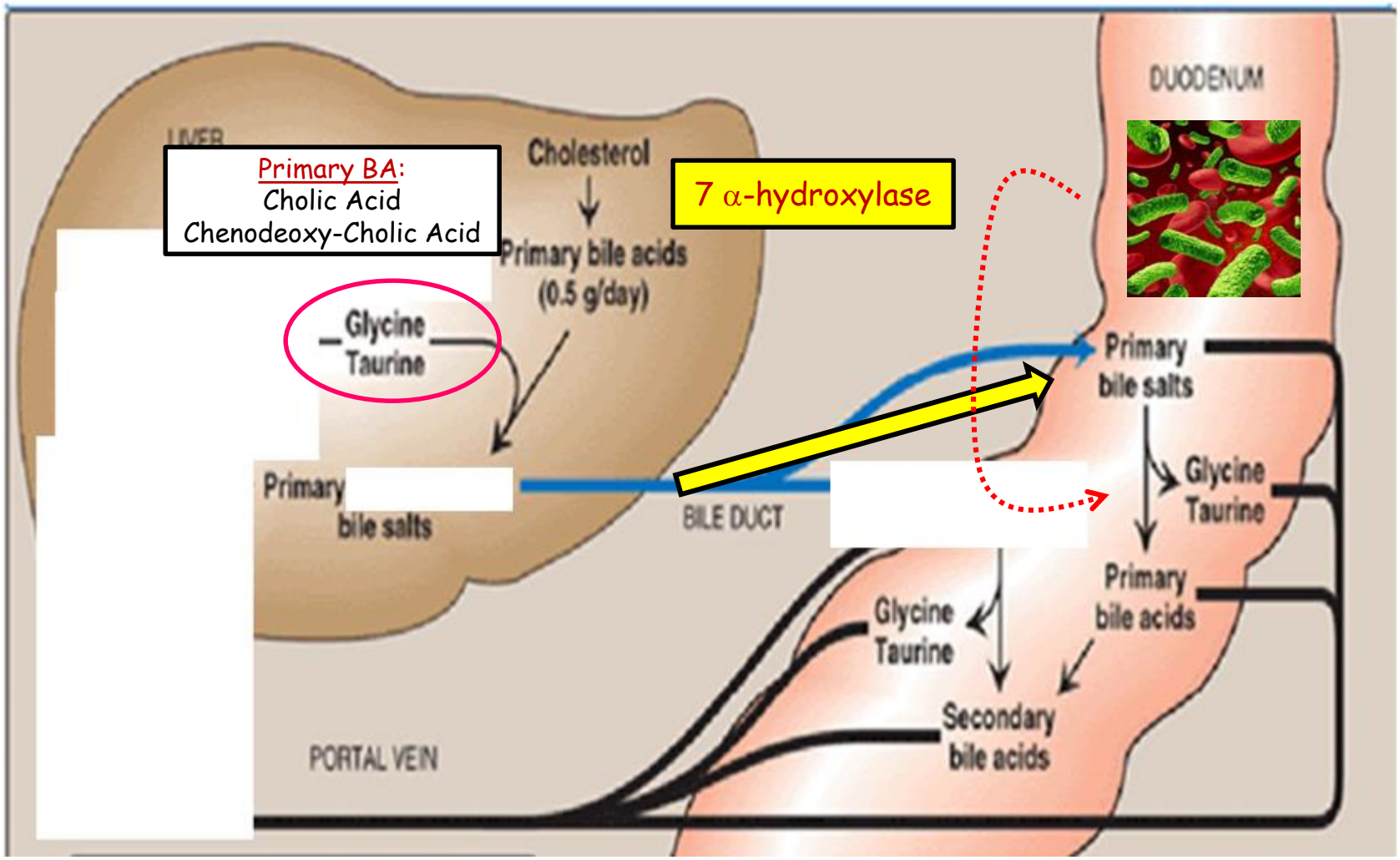


The most important point of this discussion is awareness that bile acid/salts are recycled.

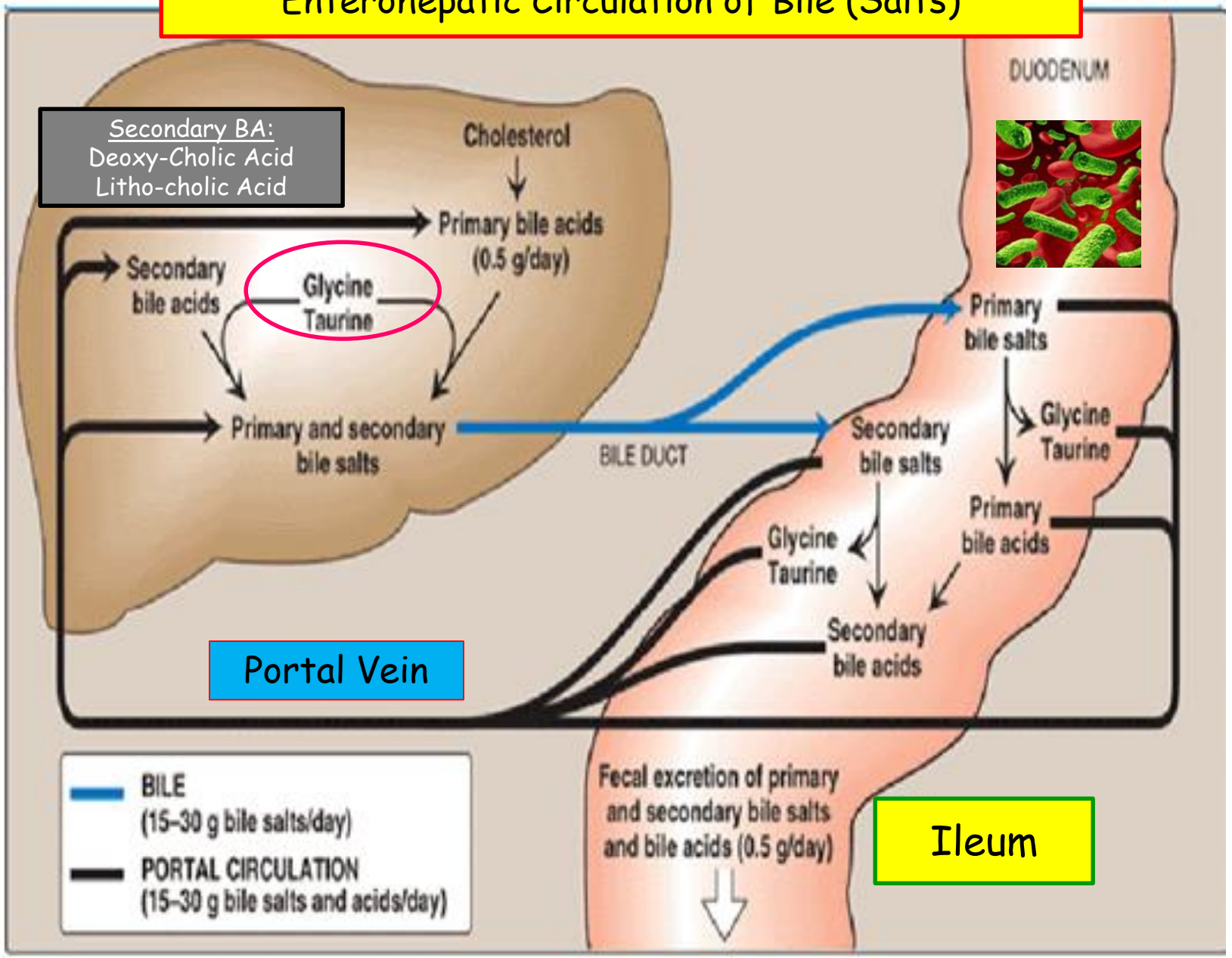
<u>Failure to do so results in two testworthy situations</u>:

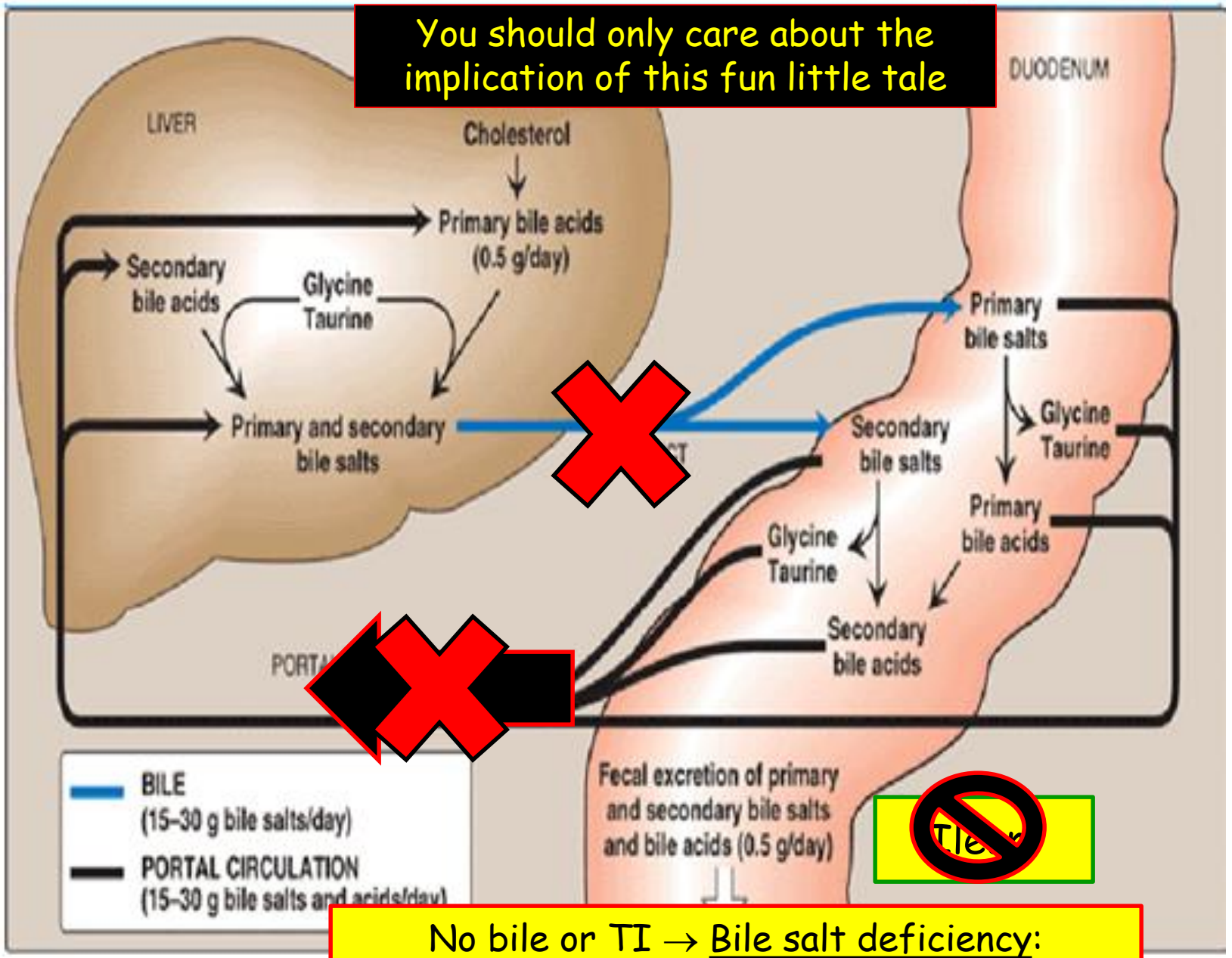
1. Fat malabsorption
2. Gallstone formation

Enterohepatic Circulation of Bile (Salts)



Enterohepatic Circulation of Bile (Salts)

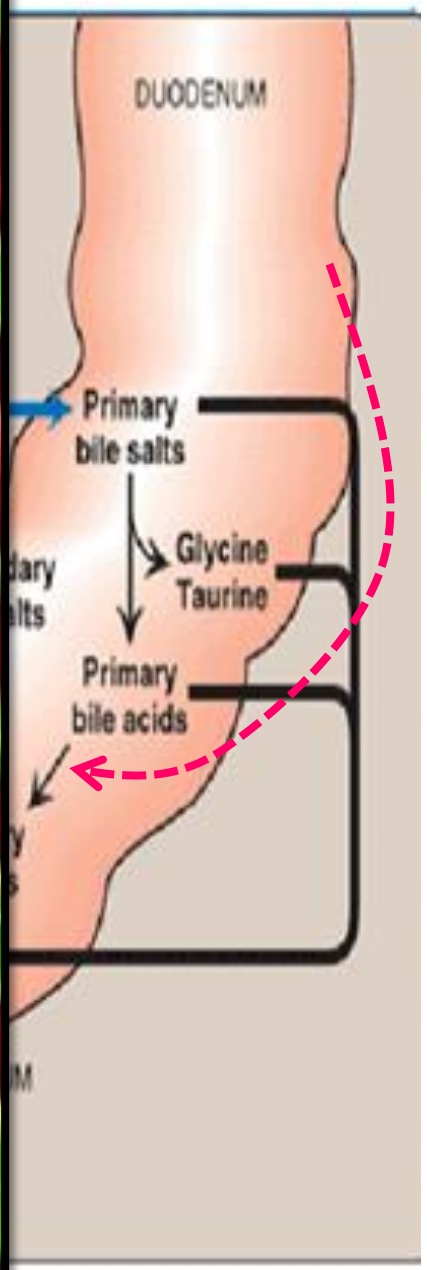




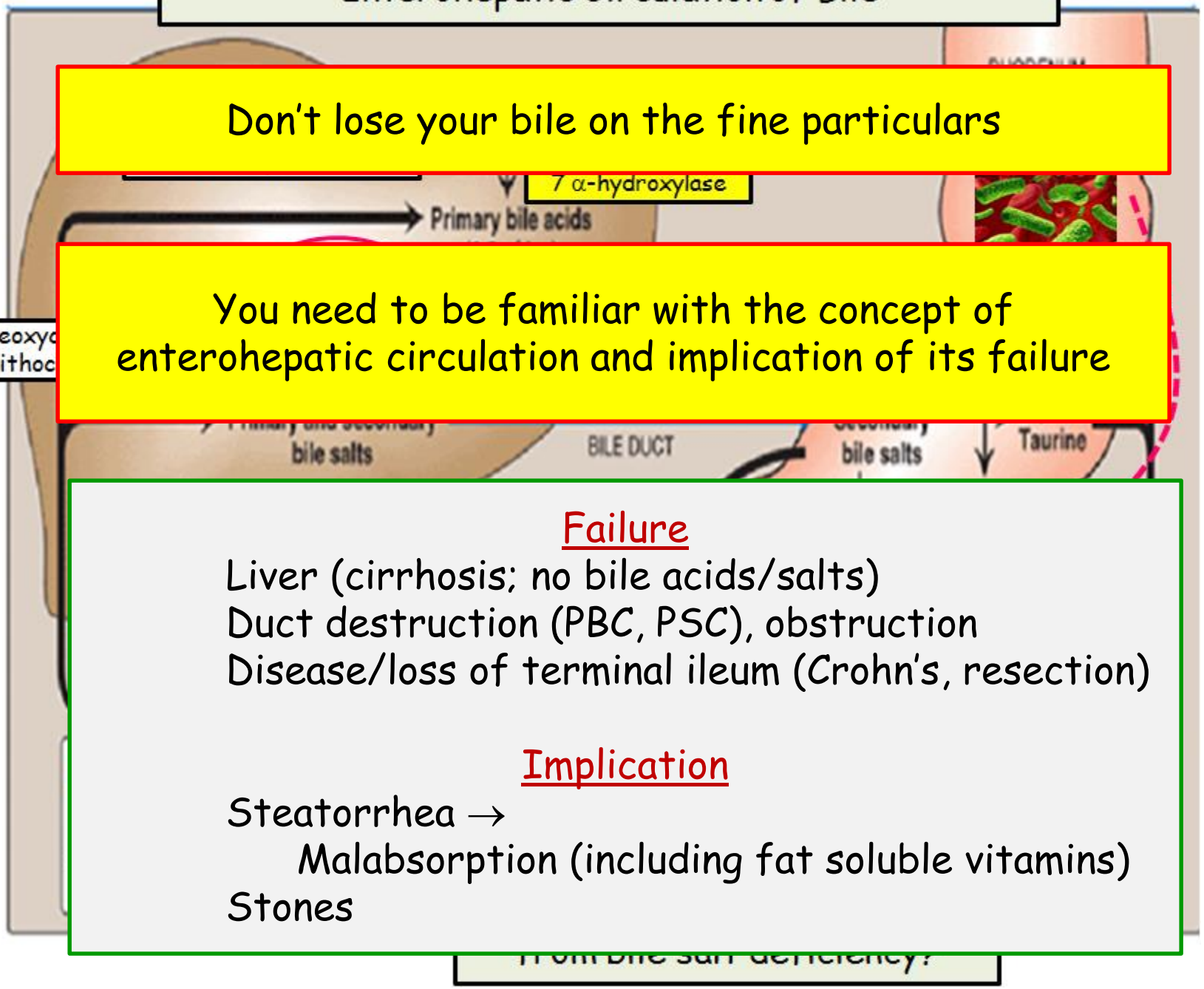
No bile or TI → <u>Bile salt deficiency</u>:
Stones (↓ BS/ ↑ Chole), Fat Vit Def, (B-12)

Bacterial Overgrowth:

- Bile salts deconjugated too soon.
- Bile acids reabsorbed (too soon) leading to incomplete absorption of fats



Enterohepatic Circulation of Bile



Don't lose your bile on the fine particulars

You need to be familiar with the concept of enterohepatic circulation and implication of its failure

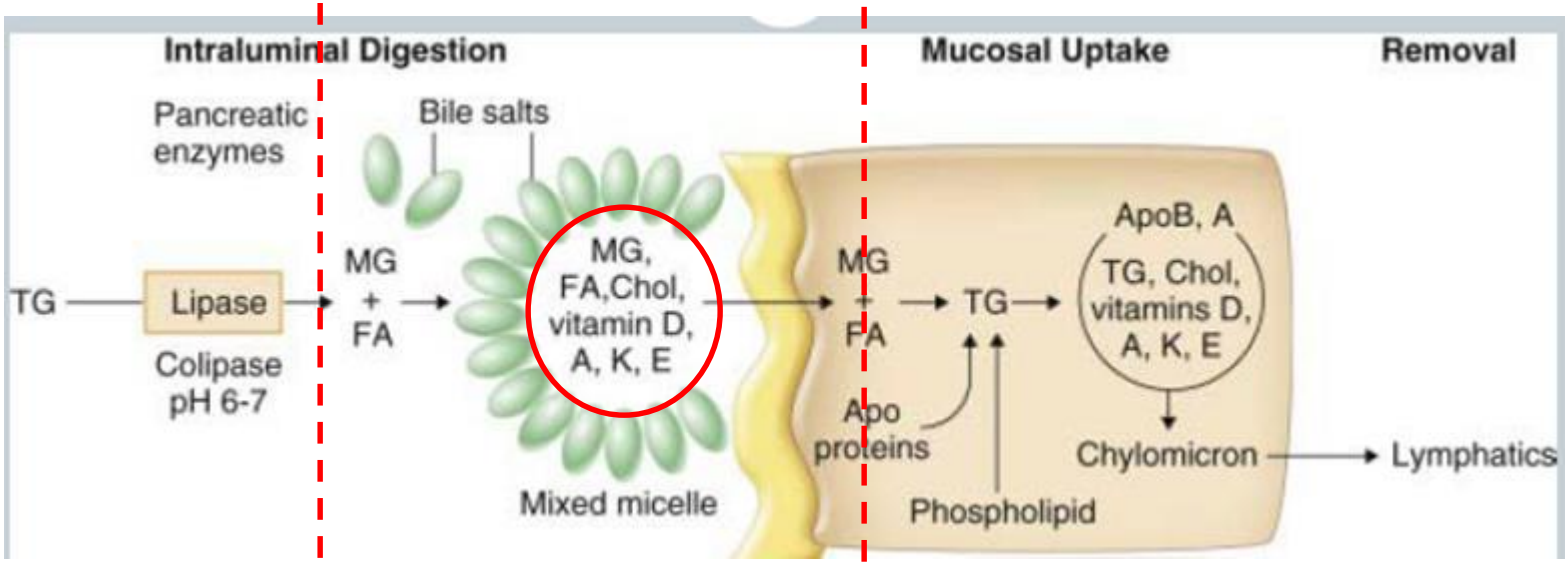
Failure

Liver (cirrhosis; no bile acids/salts)
Duct destruction (PBC, PSC), obstruction
Disease/loss of terminal ileum (Crohn's, resection)

Implication

Steatorrhea →
Malabsorption (including fat soluble vitamins)
Stones

Bile Function???



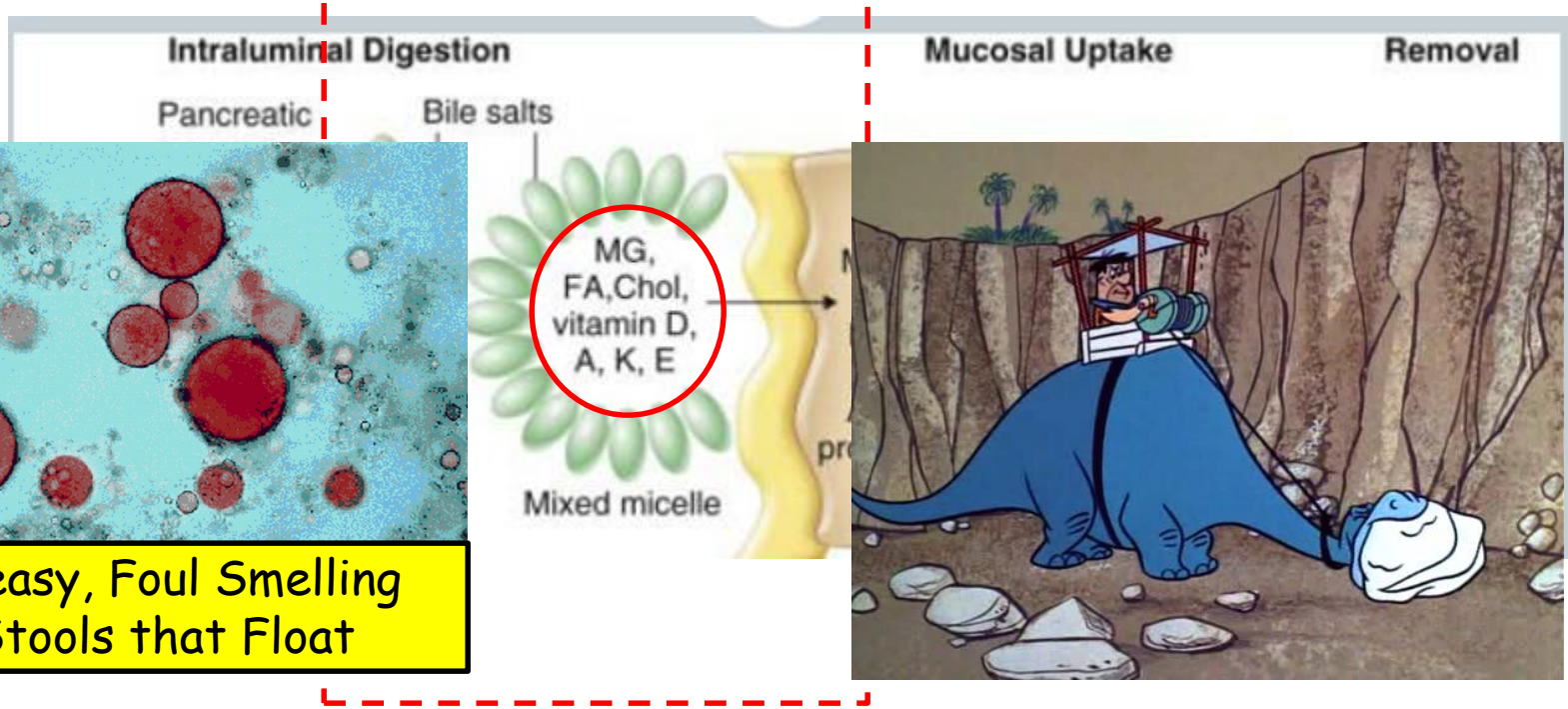
Pancreatic Lipase

Bile Salts

Enterocytes

Fat Absorption (3 components)

Bile Function???



Greasy, Foul Smelling Stools that Float

Pancreatic Lipase	**Bile Salts**	Enterocytes

Fat Absorption (3 components)

Bile WYNTKFTB

- Components
  - Bile salts, cholesterol, bilirubin
- Function
  - Emulsify fats, cholesterol excretion/secretion
- Synthesis
  - Cholesterol, 7-α hydroxylase, primary bile acids
  - Conjugation w/ taurine/glycine yields bile salts
- Enterohepatic circulation
  - Majority (85%) of bile is recycled
- Imbalance (pathology)
  - Bile salt $\downarrow$ causes steatorrhea
  - $\downarrow$ BS:cholesterol ratio associated w/ stones
- Marker of injury (pathology)
  - Alk Φ, γ-GT
  - Conjugated bilirubin

We will review bile again in context of stones/obstruction…

This was background on bile physiology…