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BILE

FORMATION &
ENTROHEPATIC
CIRCULATION



GIT

OBJECTIVES

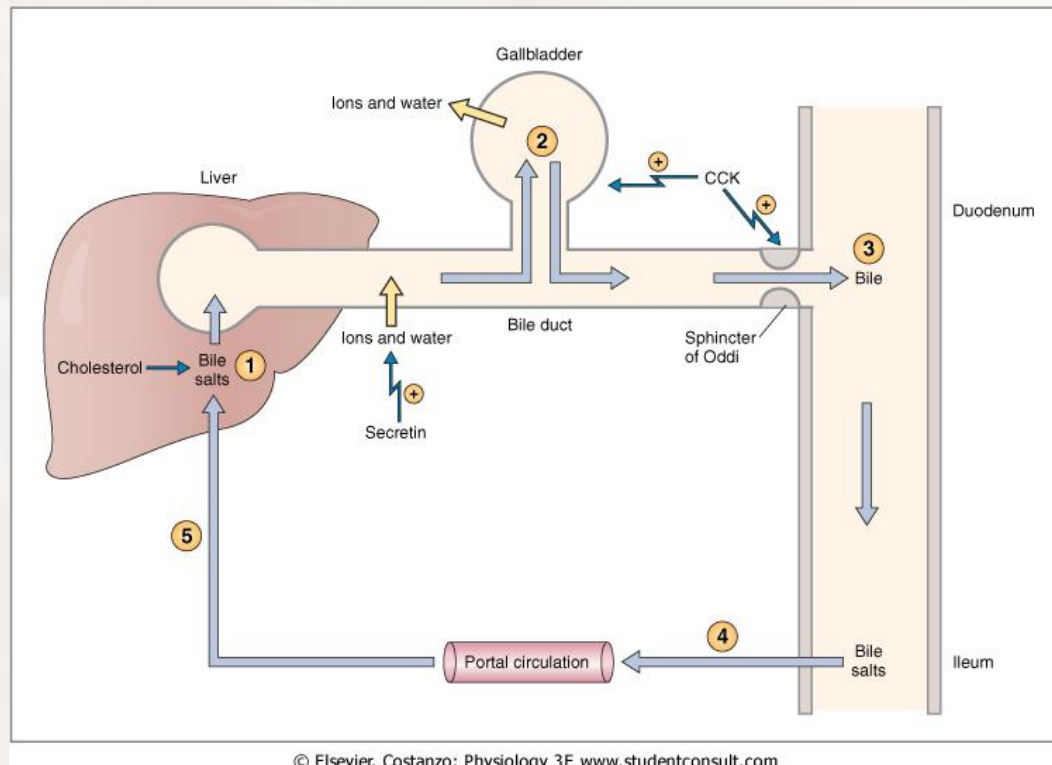
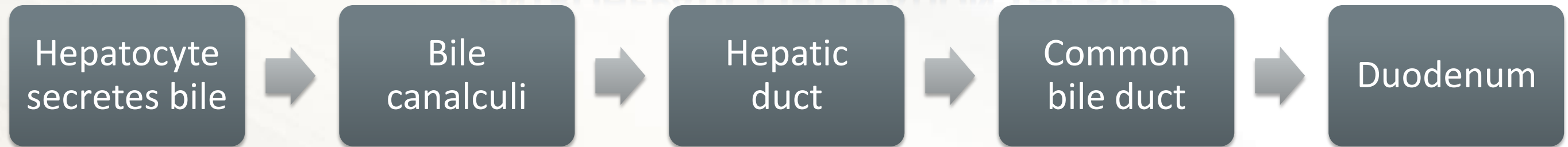
- **Functions of the bile**
- **Stages of bile secretion**
- **Characteristics of bile**
- **The main constituents of bile**
- **Functions of gall bladder**
- **Differences between hepatic bile and gall bladder bile.**
- **Control of biliary system**
 - 1. Control of choleresis**
 - **Bile acid dependent component**
 - **Bile acid independent component**
 - 2. Control of the discharge of bile into the intestine**

FUNCTION OF THE BILE

The main digestive function of the liver is **secreting bile**, bile plays a role in:

1. Fat digestion and absorption by:
 - i. Emulsifying the large particles into minute particles.
 - ii. Bile acids in absorption of the digested fat end products in the intestine.
2. Bile serves as a means for excretion of waste products from the blood e.g. **Bilirubin**

ENTROHEPATIC CIRCULATION THE BILE



Gallbladder

- The bile is stored in the gallbladder.
- Gallbladder concentrates the bile by absorption of the Na, Cl and most of other small electrolytes **by active transport and passive water movement out of lumen water follow Na.**
- Due to the absorption of NaHCO₃ by the gallbladder the pH drops (**keeps substances like Ca in acidic form**) → **prevents stones formation** .
- Between meals, bile is diverted into gall bladder.
- Bile is normally concentrated about 5-fold, but it can be concentrated up to a 20-fold.
- Buffer of biliary pressure **by storing of bile**, so it **prevents increase in biliary pressure & enables the liver to secrete bile, because hepatic cells can not secrete against high pressure.**
- It secretes mucus which has a protective function.

CHARACTERISTICS OF BILE

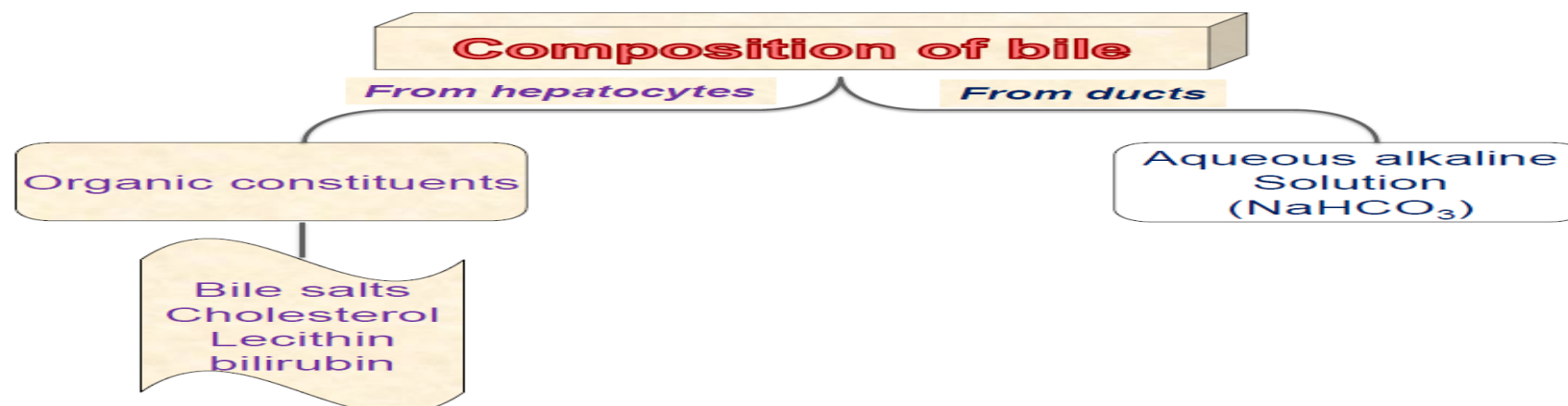
- viscous golden yellow or greenish fluid with bitter taste
- Isotonic with plasma and slightly alkaline (because of the presence of NaHCO_3)
- Daily production from liver= 5 L /day ,only 700-1200 ml/day are released into duodenum

COMPONENTS OF BILE

- **Bile consists of:**
 1. Bile acid (bile salt) (65% of dry weight of bile)
 2. Bilirubin and related bile pigments (0.3%)
 3. Phospholipids (90% of phospholipids is lecithin) (20%)
 4. Proteins (5%)
 5. Cholesterol (4%), the major route for cholesterol excretion is bile (cholesterol solubility depends on concentration of bile salts , cholesterol and phospholipids)
- 6. Electrolytes mainly HCO_3^- (which participates with pancreatic and duodenal secretion in neutralization of acid chyme)
- 7. Water

Secreted by the **hepatocytes** in to the bile canaliculi along with an **isotonic fluid** that resembles plasma in its electrolyte conc

Secreted by the **epithelial cells that line bile ducts**, and contribute to the volume of bile leaving the liver



- Concentration of Na^+ , HCO_3^- and Cl^- in the gall bladder bile is less than the one in the hepatic bile because of active transport of Na^+ , Cl^- and HCO_3^-
- PH also less because of in the decreasing in NaHCO_3 concentration .

	Hepatic bile	Gall bladder bile
Water	% 98	% 89
Total solids	2-4 %	11 %
Bile salts	26	145
Bilirubin	0.7	5
Cholesterol	2.6	16
Phospholipids	0.5	4
Na^+	145	130
HCO_3^-	28	10
Ca^{++}	5	23
Cl^-	100	25
K^+	5	12
pH	8.3	7.5

CONTROL OF BILIARY SYSTEM

- Between meals, the human liver secretes bile at a pressure of 25 cm H₂O and the sphincter of Oddi is normally closed offering resistance of about 30 cm H₂O → so the Bile secreted by liver is thus diverted to the gall bladder during the interdigestive periods.
- Pressure in the lumen of the gall bladder varies between 0-16 cm H₂O

CONTROL OF CHOLERESIS

Substances that stimulate hepatic secretion of bile (**choleresis**) are **choleretics**.

1) **Bile acid dependent component** (Bile secretion from hepatocytes is active transport of bile acids into canaliculi with passive H₂O flow along osmotic gradient)

-The bile acid dependent component depends mainly on the integrity of the enterohepatic circulation.

So, ↑ **portal blood flow** → ↑ **bile secretion**

-90% of the rate of secretion of bile acids is determined by the rate of clearance of **reabsorbed bile acids from the portal vein (90% reabsorbed and 10% excreted in stools)**

-The remaining 10% is due to synthesis of new bile acids by hepatocytes

2) **Bile acid independent component** (In the biliary ducts **HCO₃⁻** is secreted independently of bile acid secretion & is followed passively by water)

stimulated by:

1. Hormones as **secretin, CCK, gastrin** and **glucagon**.

2. Vagal stimulation (**indirect way : stimulation of gastric secretion → which leads to secret secretin and CCK**)



Increase portal blood flow during digestion increases bile secretion, But when the liver is markedly congested bile secretion stops due to increase intrahepatic vascular pressure.

Secretin via blood stream stimulates liver ductal secretion

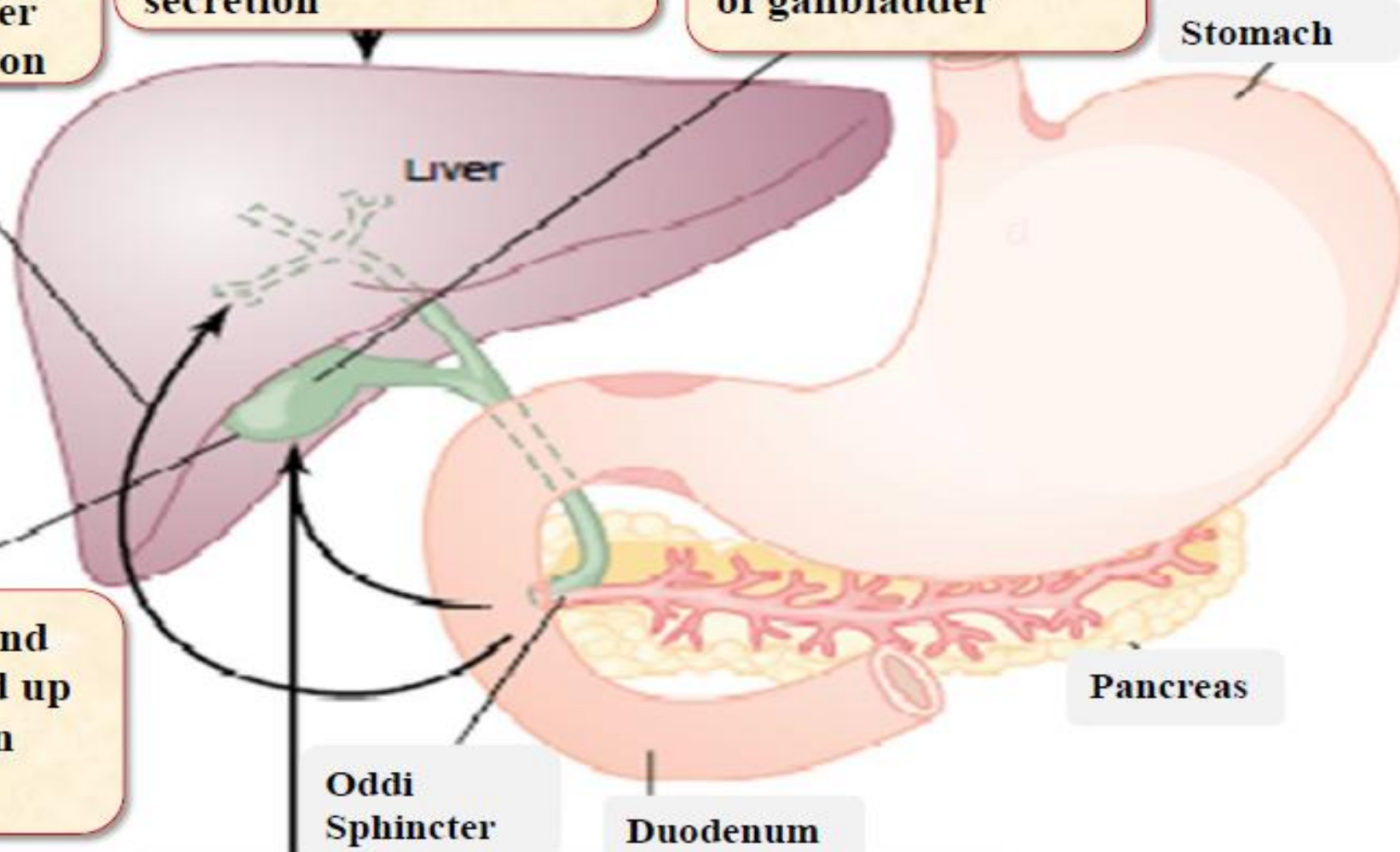
Bile acids via blood stimulate parenchymal secretion

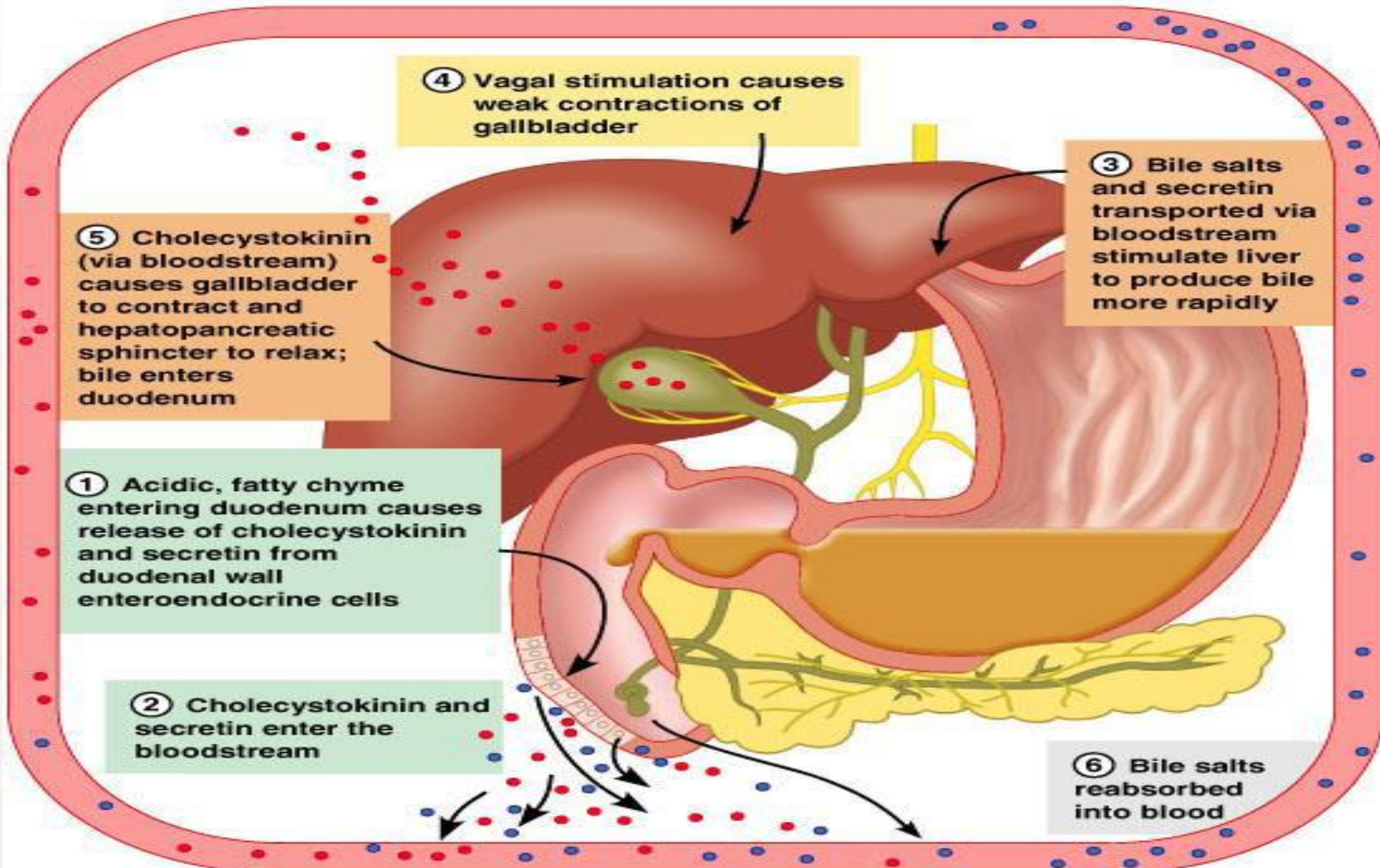
Vagal Stimulation causes contraction of gallbladder

Bile stored and concentrated up to 15 times in gallbladder

Cholecystikinin via blood stream causes:
1. Gallbladder contraction
2. Relaxation of sphincter of Oddi

Liver secretion and gallbladder emptying





④ Vagal stimulation causes weak contractions of gallbladder

③ Bile salts and secretin transported via bloodstream stimulate liver to produce bile more rapidly

⑤ Cholecystokinin (via bloodstream) causes gallbladder to contract and hepatopancreatic sphincter to relax; bile enters duodenum

① Acidic, fatty chyme entering duodenum causes release of cholecystokinin and secretin from duodenal wall enteroendocrine cells

② Cholecystokinin and secretin enter the bloodstream

⑥ Bile salts reabsorbed into blood

CONTROL OF DISCHARGE OF BILE INTO THE INTESTINE

Discharge of bile into the duodenum occurs by contraction of gall bladder wall and relaxation of Oddi sphincter.

Gall bladder evacuants are called **cholagogues**, the highest emptying of the gall bladder occurs during **intestinal phase**

1) Nervous component

Parasympathetic (vagal) stimulation:

- contraction of the gallbladder
- relaxation of the sphincter of Oddi
- ↑ bile formation.

2) Hormonal component

The presence of digestive products → releases CCK from the upper intestine in to the blood → contracts gall bladder and relaxes sphincter of Oddi, thus discharging bile into the duodenum.

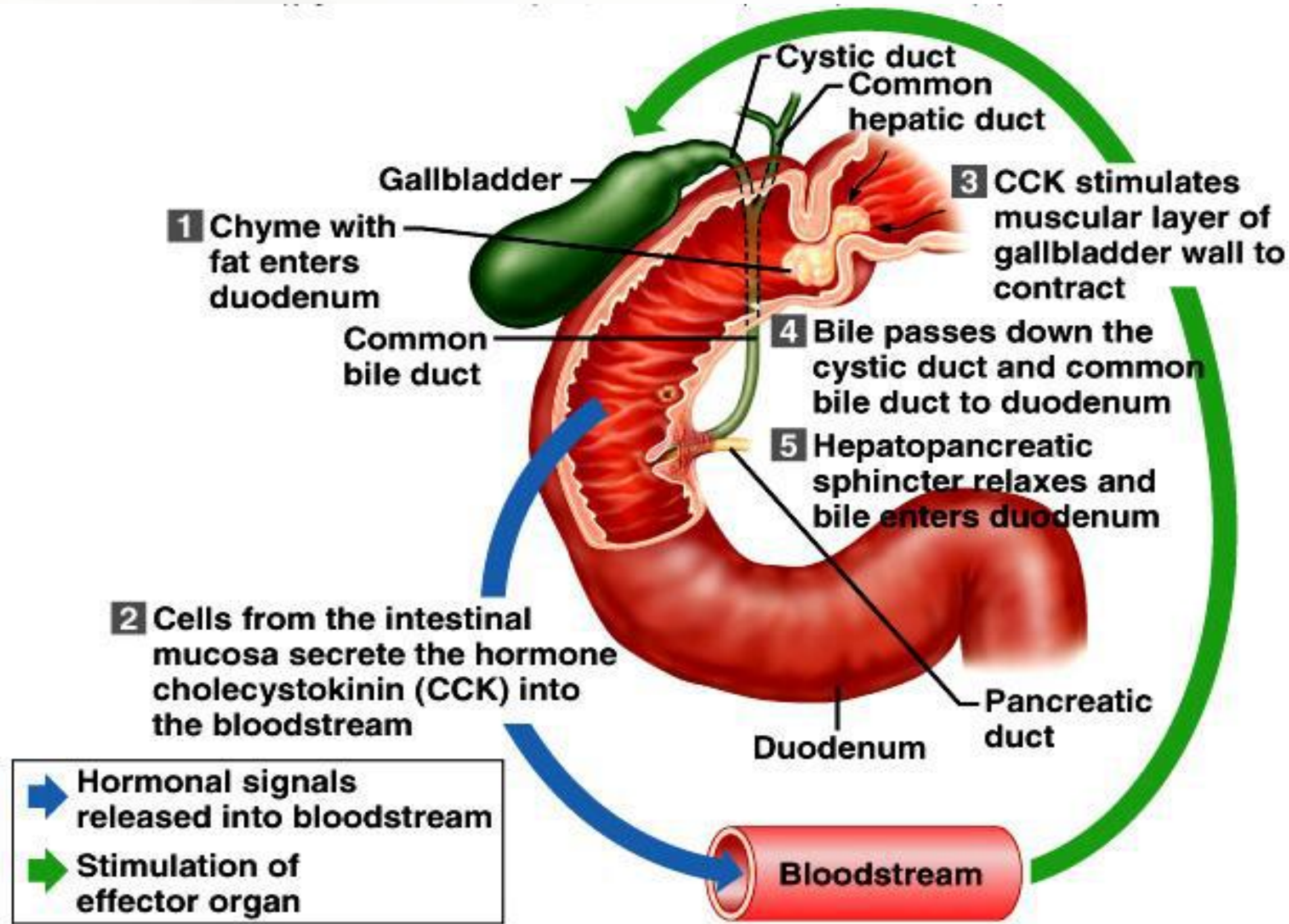
* Vagal excitation & secretin augment the action of CCK on the gall bladder

Bile secretion will be reduced in case of :

- A. Vagotomy
- B. Stimulation of sympathetic nervous system → relaxation of the gall bladder

****REMEMBER

1. Secretion of bile from the hepatocytes is called choleresis and it is stimulated by choloretic .
2. Gall bladder evacuants are called cholagogues





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GOOD LUCK

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