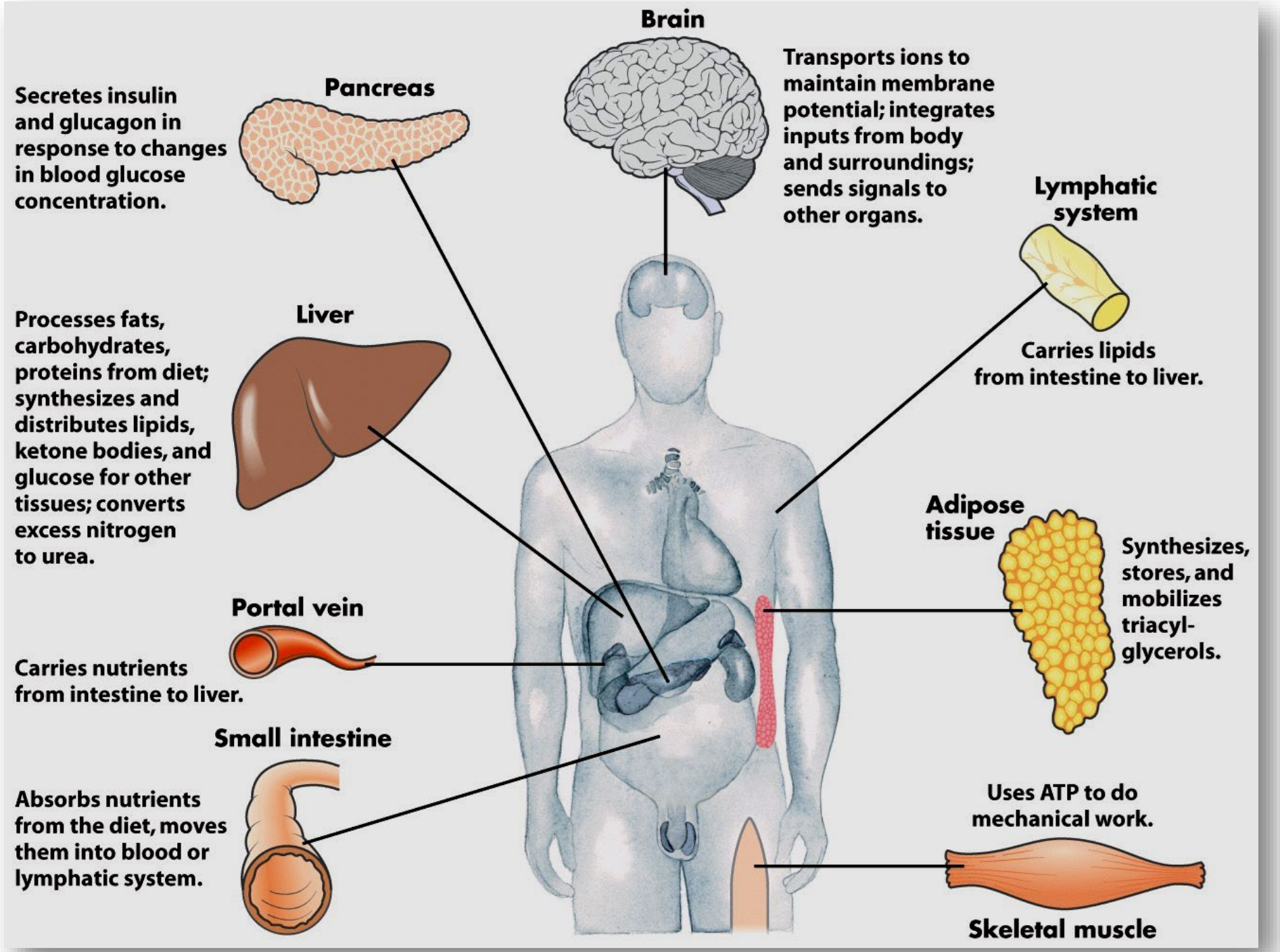
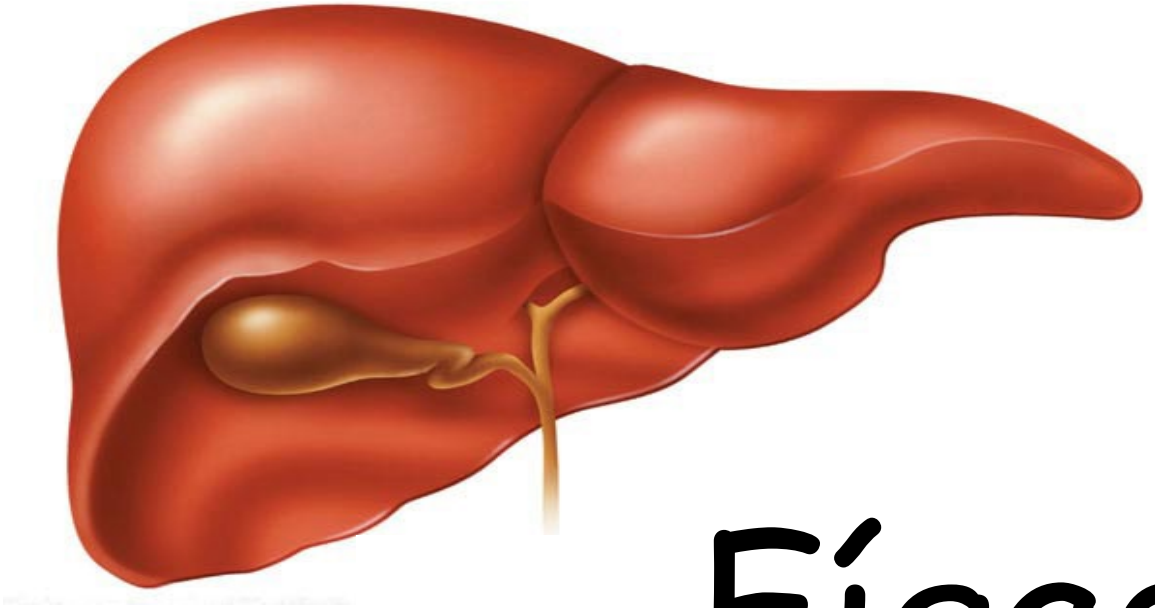
Reservas de Energia no homem pelos diferentes tecidos

	Available energy in kcal (kJ)		
Organ	Glucose or glycogen	Triacylglycerols	Mobilizable proteins
Blood	60 (250)	45 (200)	0 (0)
Liver	400 (1700)	450 (2000)	400 (1700)
Brain	8 (30)	0 (0)	0 (0)
Muscle	1,200 (5000)	450 (2000)	24,000 (100,000)
Adipose tissue	80 (330)	135,000 (560,000)	40 (170)

Source: After G. F. Cahill, Jr. *Clin. Endocrinol. Metab.* 5(1976):398.


Brain
Transports ions to maintain membrane potential; integrates inputs from body and surroundings; sends signals to other organs.
Pancreas
Secretes insulin and glucagon in response to changes in blood glucose concentration.
Lymphatic system
Carries lipids from intestine to liver.
Liver
Processes fats, carbohydrates, proteins from diet; synthesizes and distributes lipids, ketone bodies, and glucose for other tissues; converts excess nitrogen to urea.
Adipose tissue
Synthesizes, stores, and mobilizes triacyl-glycerols.
Portal vein
Carries nutrients from intestine to liver.
Small intestine
Absorbs nutrients from the diet, moves them into blood or lymphatic system.
Uses ATP to do mechanical work.
Skeletal muscle

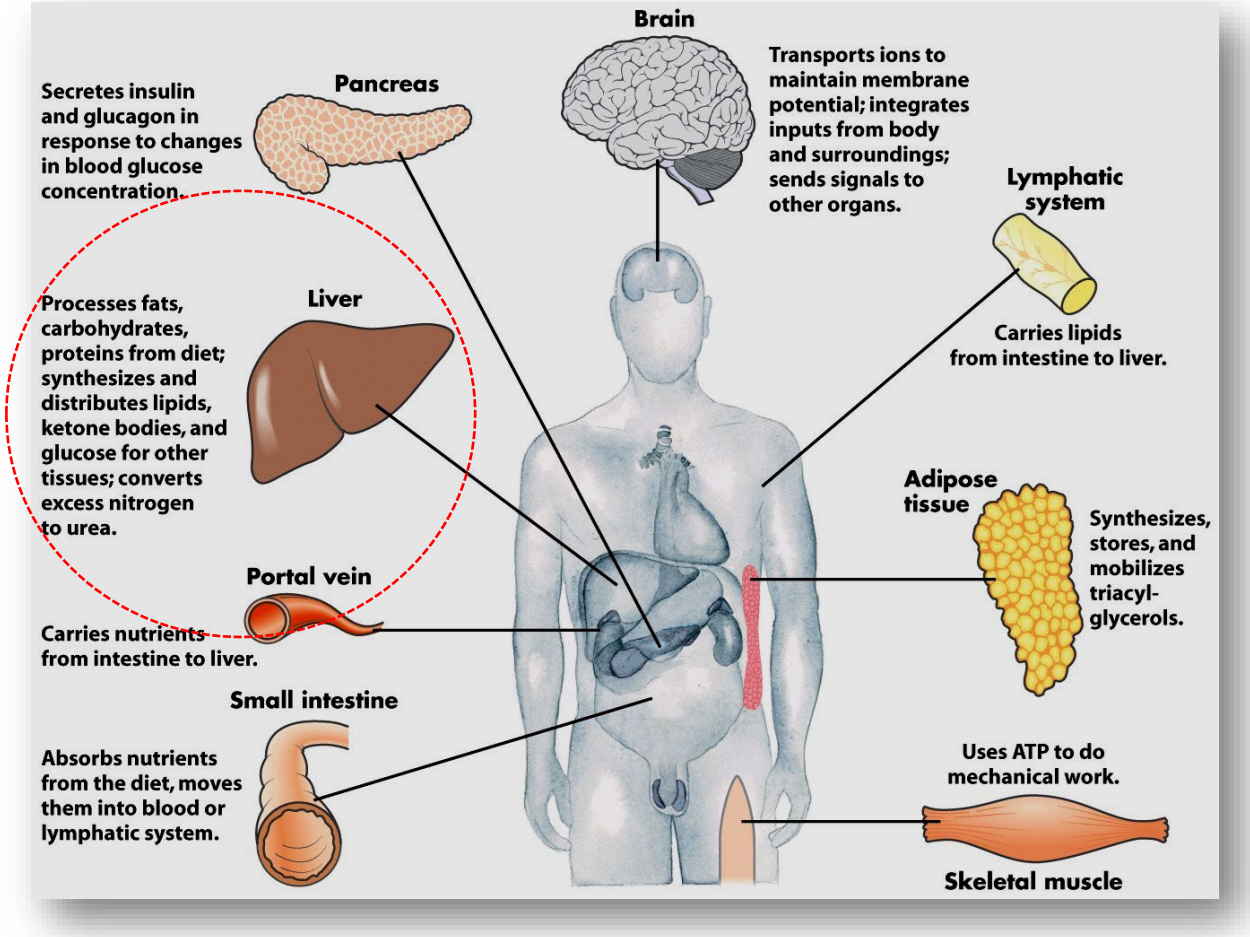


Fígado

Câmara de compensação metabólica central do corpo!

-Orgão com uma das maiores capacidades adaptativas.

-Responsável pela manutenção da glicemia

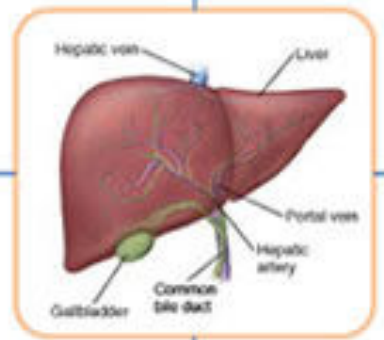


The functions of the liver and its implications

Metabolism and detoxification of:
- Alcohol
- Drugs
- Steroidal hormones
- Non steroidal hormones
- Insulin
- Growth hormones

Excess carbohydrates Intake → Triglycerides (TG) → Dyslipidaemia

Metabolism of carbohydrates → Simple Carbohydrates (Fructose and galactose) → CLUGOSE → Glycogen



- Stores Vit A, D, E, K, B12
- Stores minerals Zn, Fe, Cu, Mg

Production and regulation of:
- Triglycerides
- Phospholipids
- Lipoproteins
- Cholesterol
- Acetyl-CoA

Bile synthesis
Converts carotene to Vit A
Converts folate to 5-MTHF
Converts Vit D to 25-hydroxylcholecalciferol
Converts ammonia to urea

Protein metabolism

- Non-essential amino acids
- Functional proteins(fibrinogen prothrombin) for clotting
- Transferrin for transport of iron
- Lipoprotein for transport of cholesterol
- Globulins for immune function
- Albumin for oncotic pressure

Disturbed protein metabolism → Bleeding disorders, Excess bruising, Ascites, Impaired immune function, Anaemia and fatigue

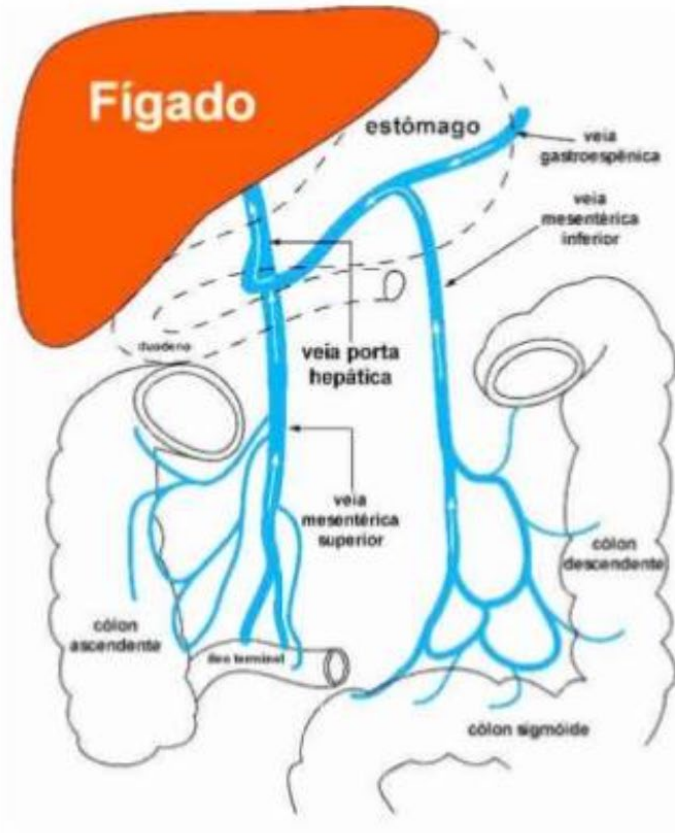
North Brisbane Naturopathy

Tipos de circulação

Portal – interposição de uma veia entre duas redes de capilares, sem passar por órgão intermediário.

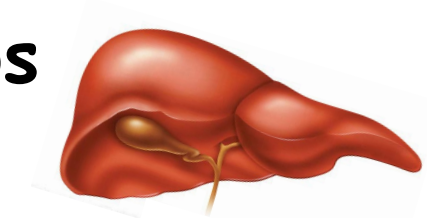
Ex: circulação portal-hepática

Veia porta fica localizada entre a rede de capilares do fígado e a rede capilar do intestino e tem como objetivo armazenar excessos de açúcares da digestão no fígado depois de uma refeição e liberar os açúcares armazenados no fígado como glicogênio, entre as refeições, visando manter o nível de glicose no sangue.

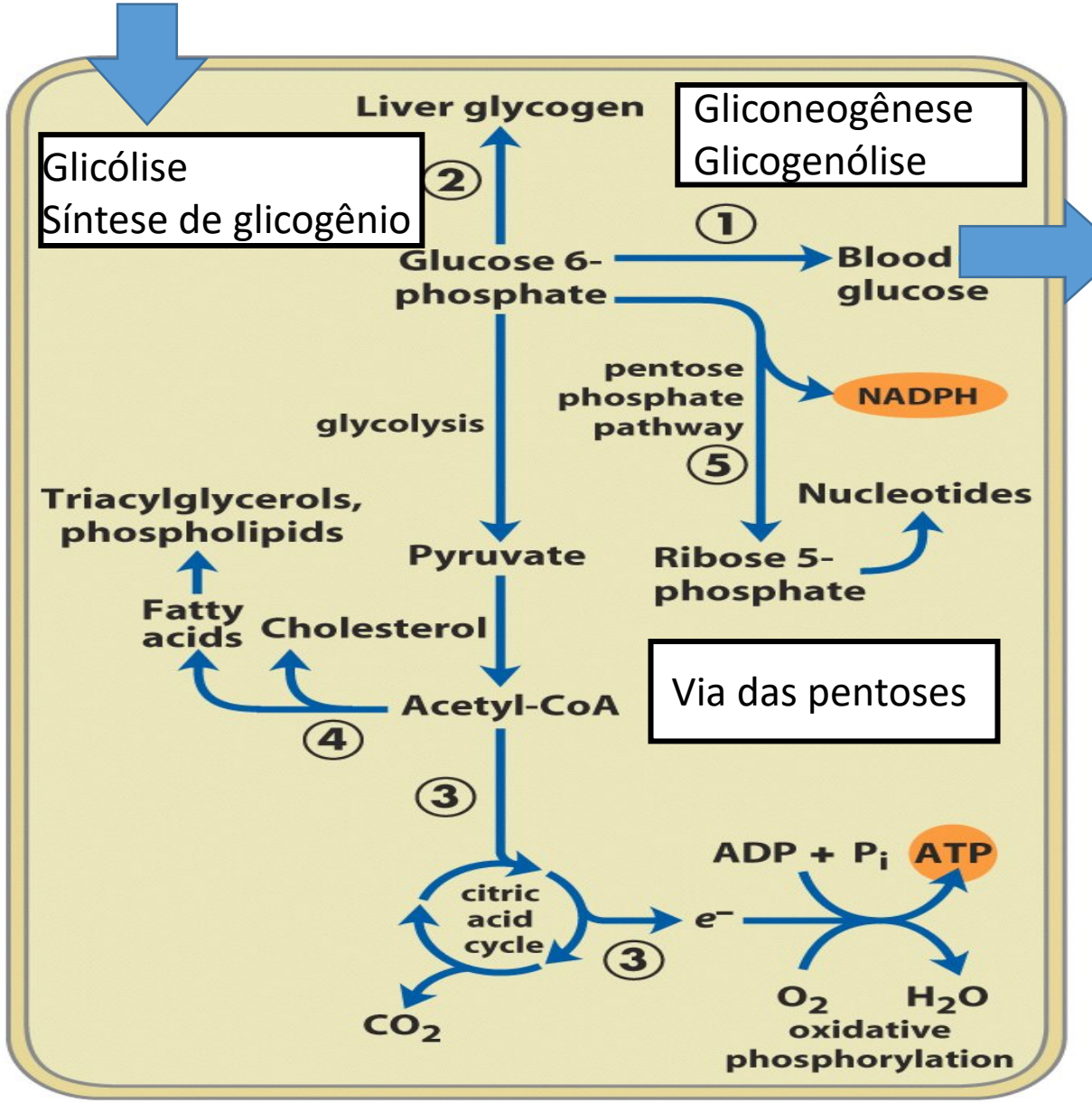


https://youtu.be/mMKdUgNdhBs

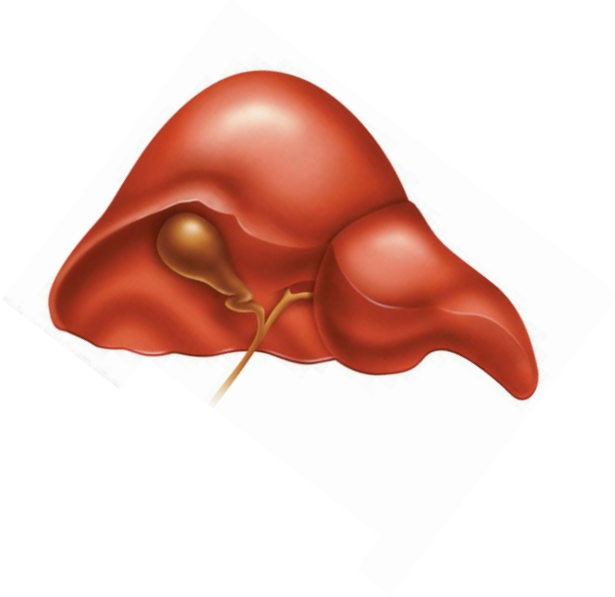
Fígado e metabolismo de carboidratos



Glicose

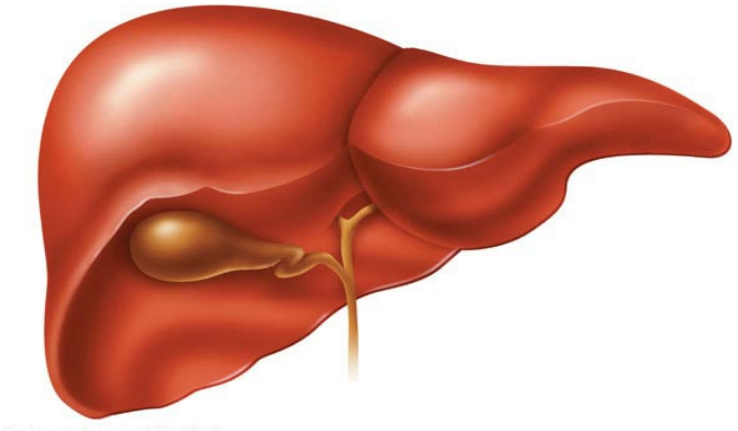


Fígado



Carboidratos

Regulação enzimática e de transportadores



Glut 1, 3 e 4 alta afinidade por glicose Km entre 2 e 4 mM.

Glut 2 Km= 15 a 25 mM.

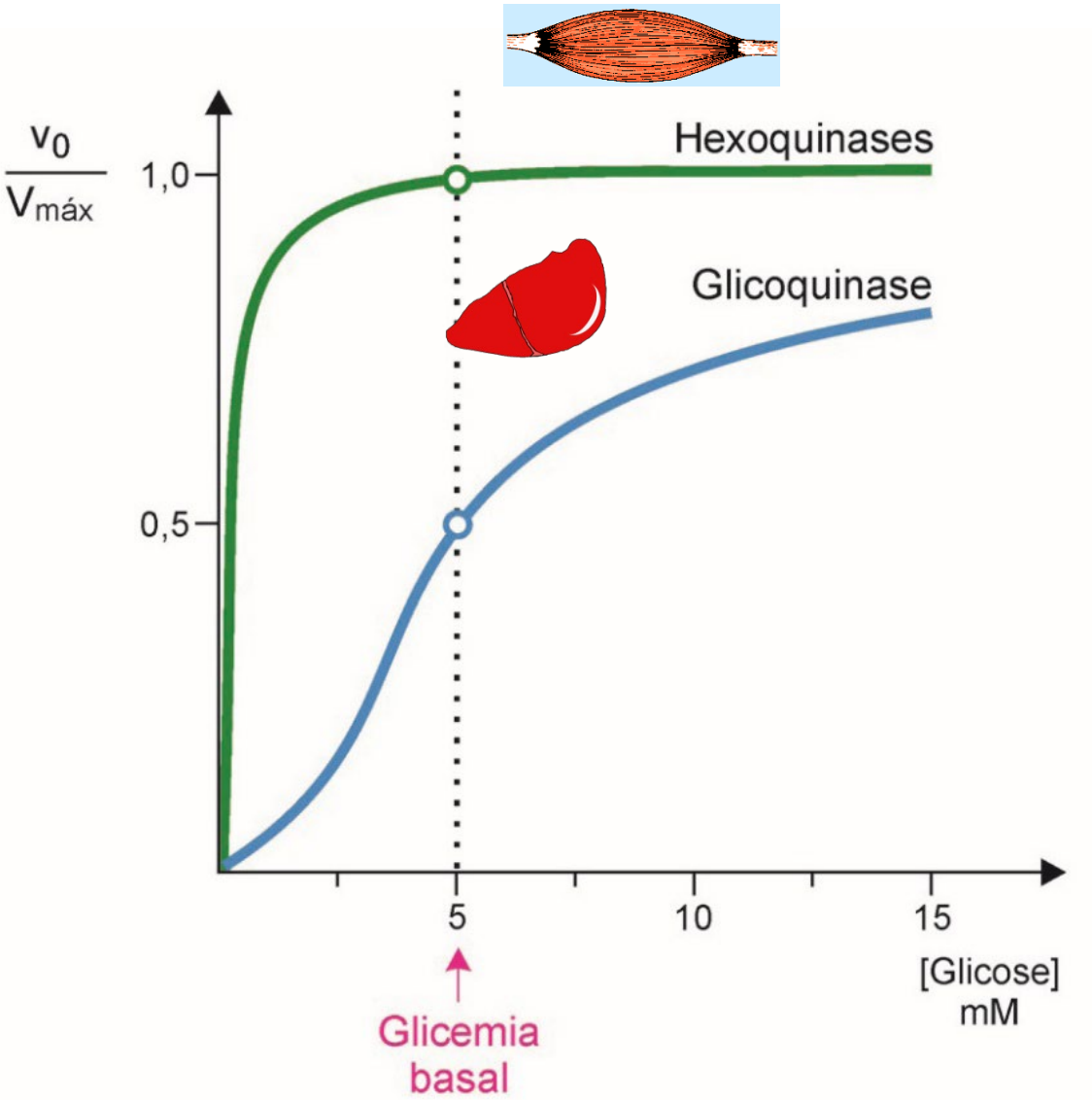
Glut 4 dependente de insulina

GLUT2: Km alto possibilita o transporte de glicose em situações de hiperglicemia

Conc. glicose hepatócito = sangue

Glicoquinase

Glicose + ATP ⟶ Glicose 6-fosfato + ADP + H^+



Glicoquinase (fígado)
Comportamento alostérico
Menor afinidade pela glicose

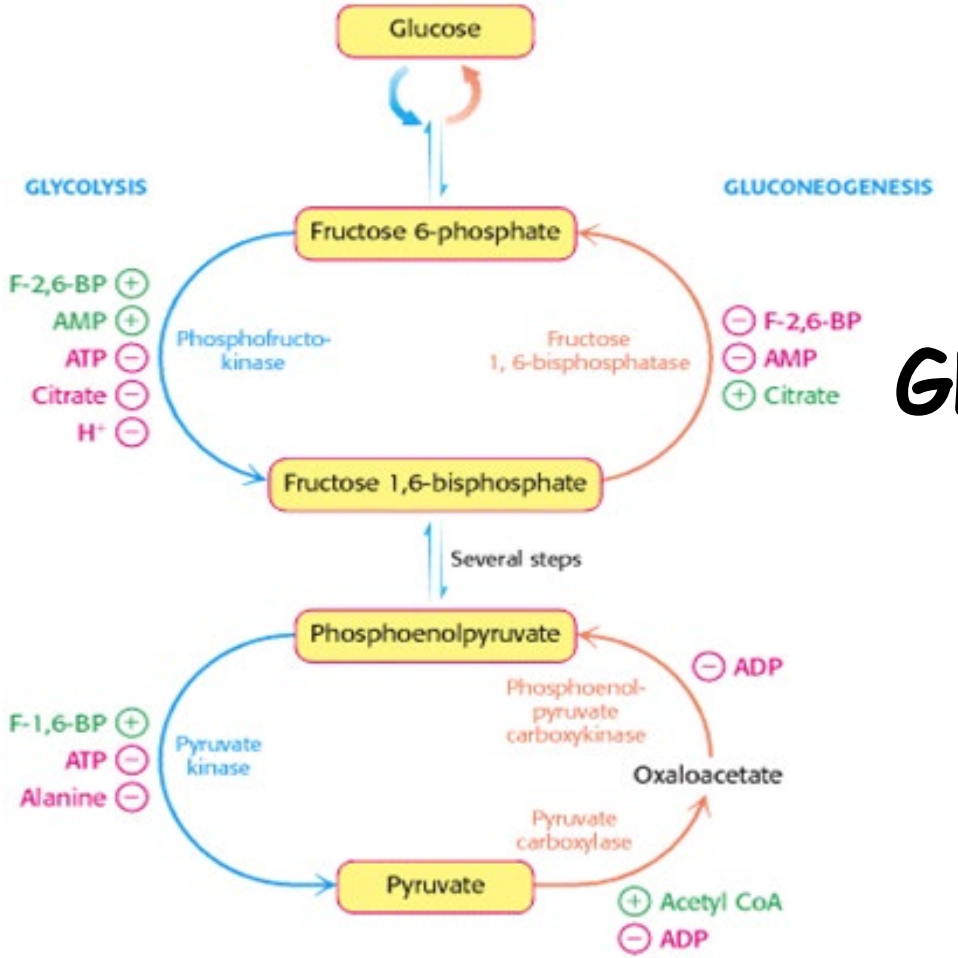
Não é inibida pela **glicose-6 fosfato**.

Ativa apenas em altas concentrações de glicose.

As enzimas mais propensas a serem locais de controle são as que catalisam as reações irreversíveis.

Regulação alostérica destas enzimas

GLICÓLISE



GLICONEOGÊNESE

Glicólise

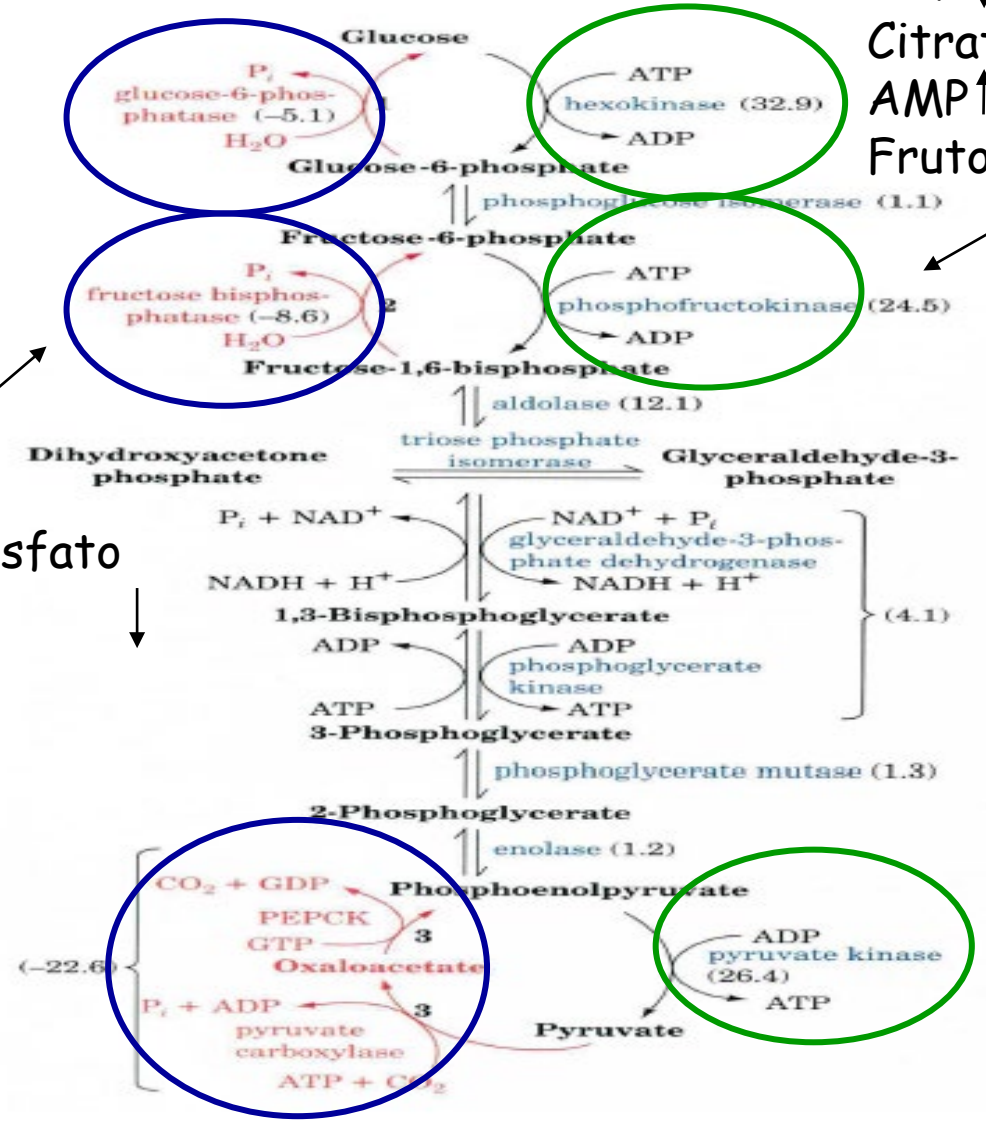
Fosfofrutoquinase 1

ATP ↓

Citrato ↓

AMP ↑

Frutose 2, 6 bisfosfato ↑

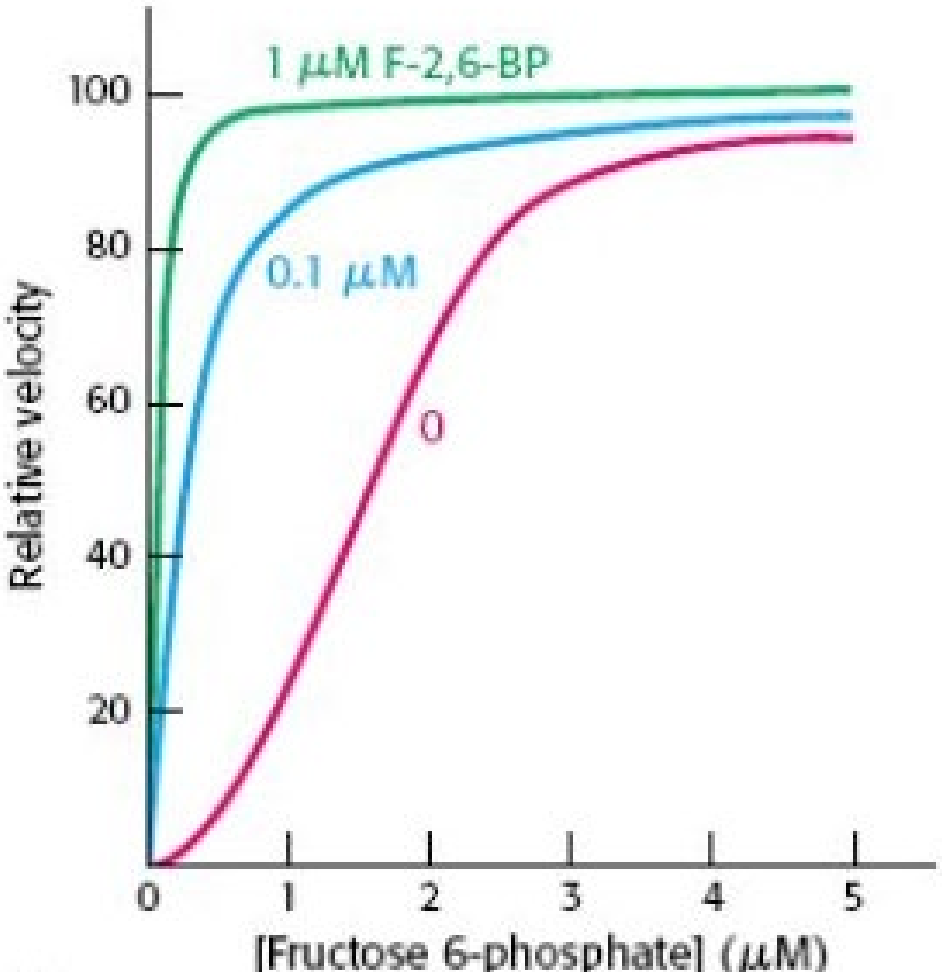


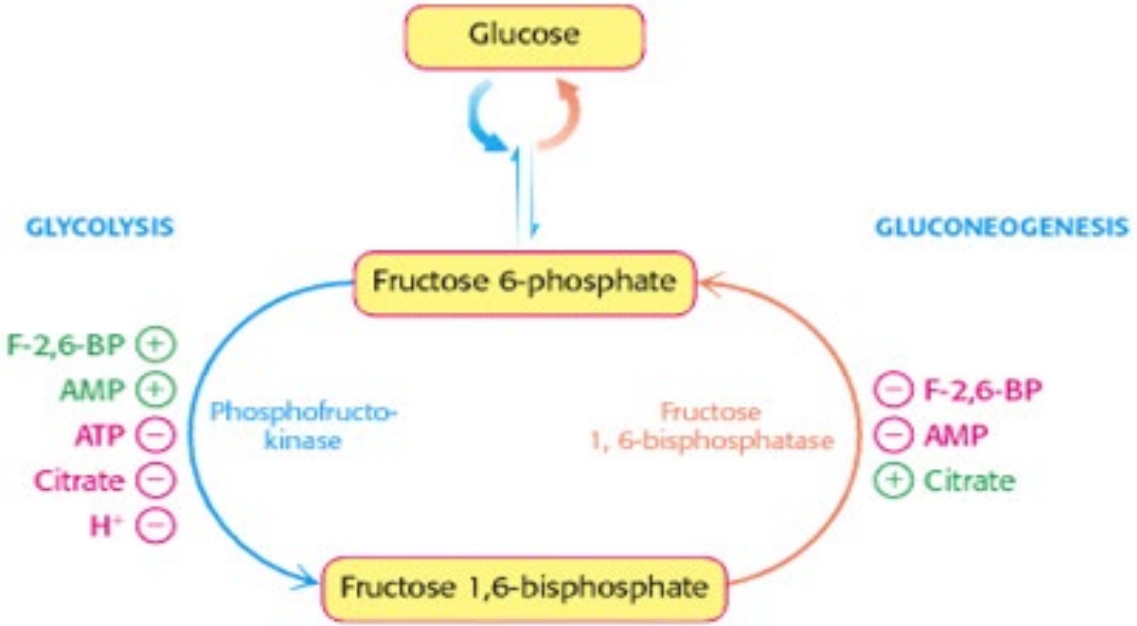
Frutose 2, 6 bisfosfato

Gliconeogênese

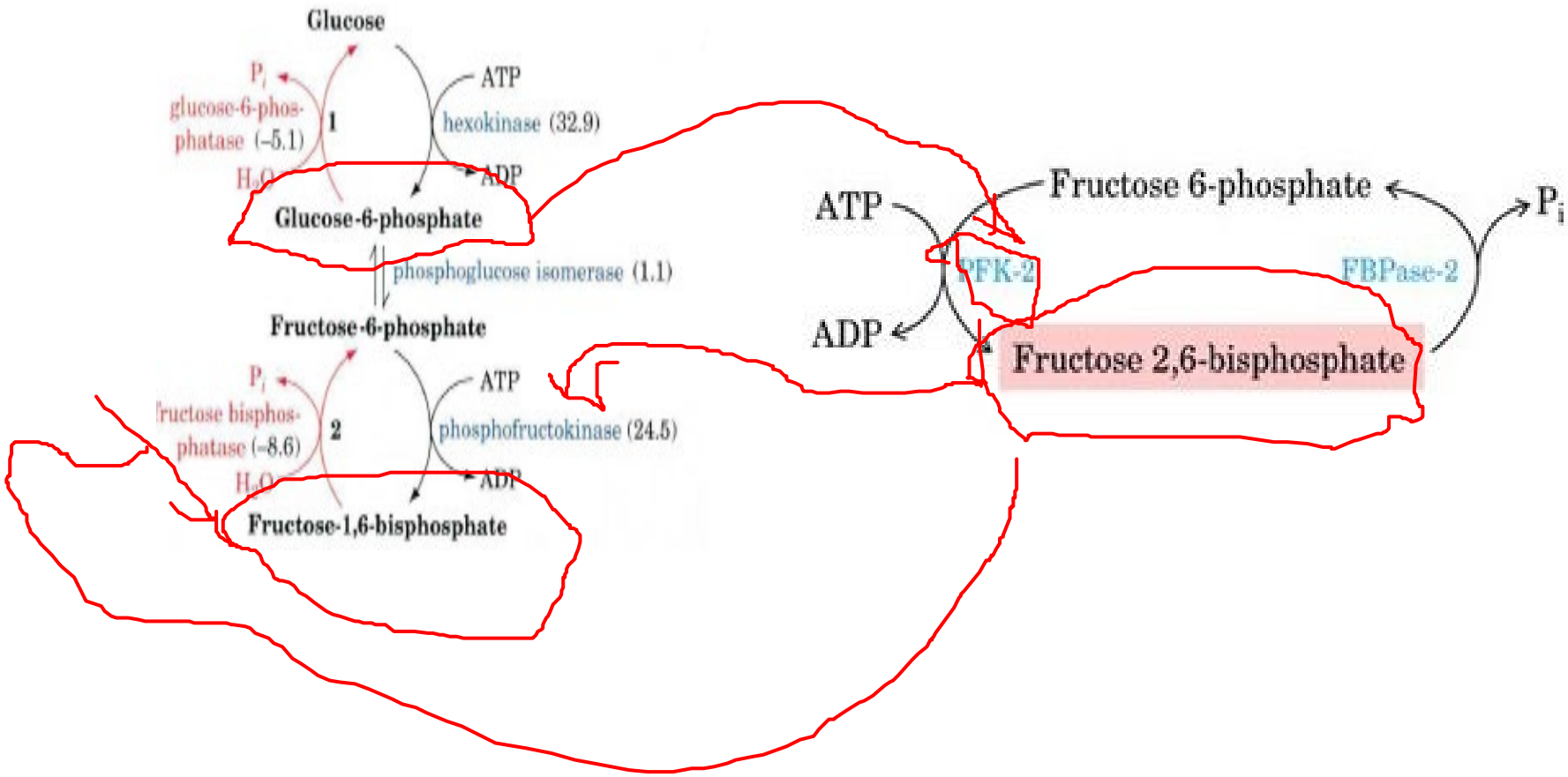
Atividade da fosfofrutoquinase

Frutose 6 fosfato +ATP → Frutose 1,6 bisfosfato +ADP + Pi

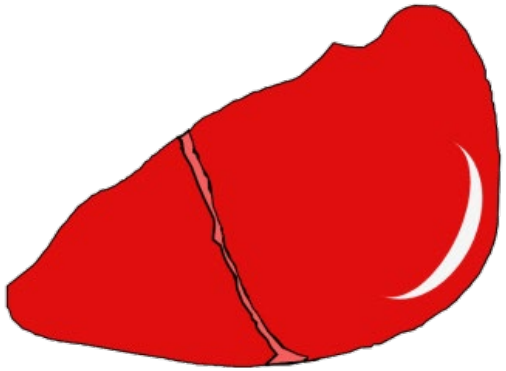


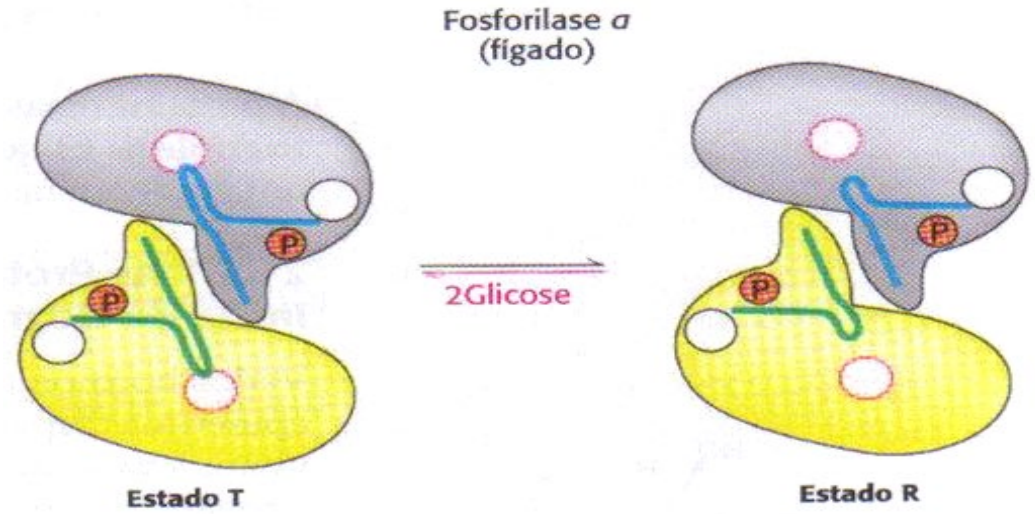


Frutose 2, 6 bifosfato



Metabolismo do Glicogênio
Fosforilase Hepática
(Fosforilase a)





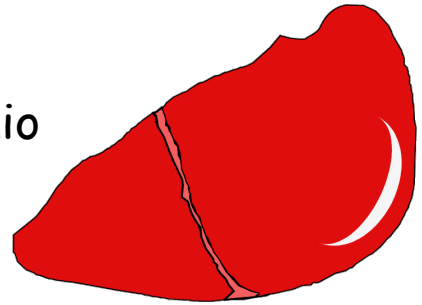
1- Ao contrário do músculo, a Fosforilase a é a mais susceptível a transição T e R no fígado.

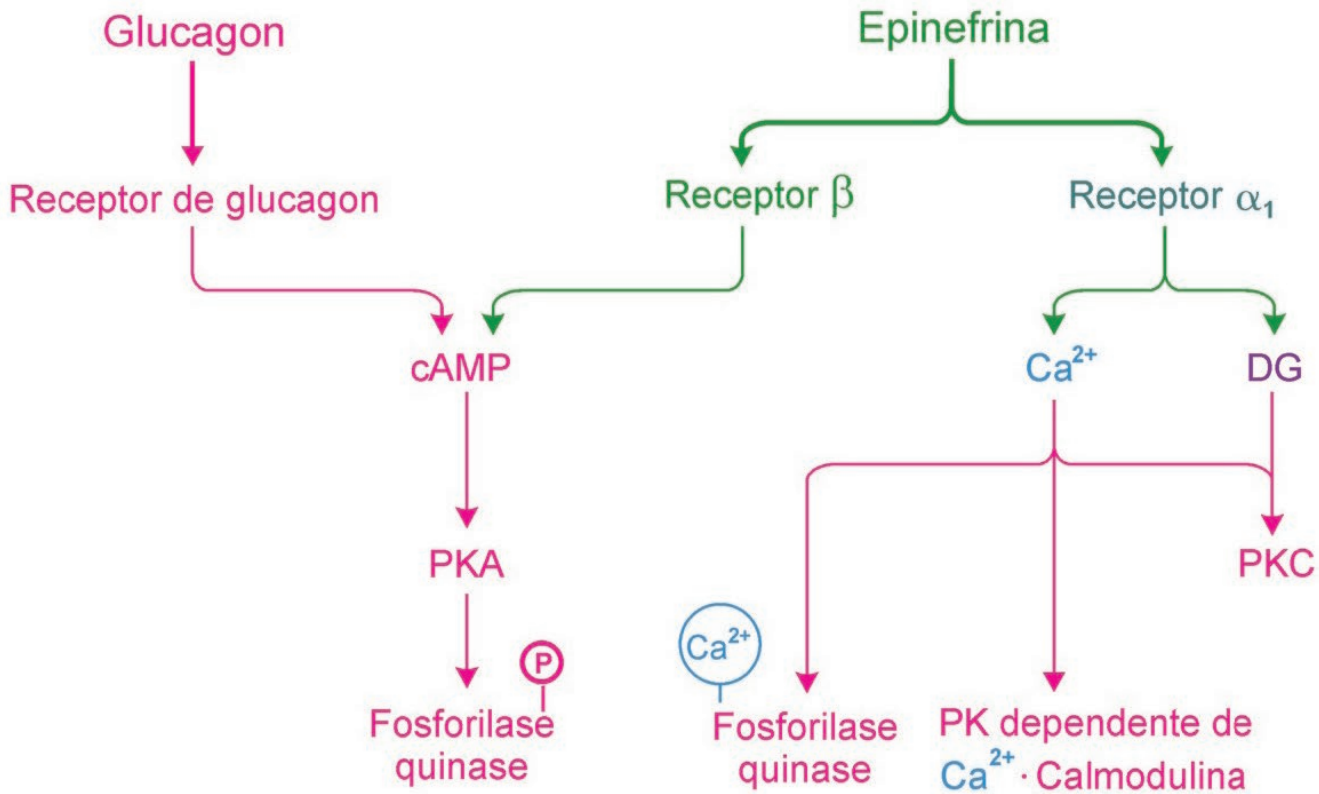
2- A Fosforilase a não é sensível ao AMP porque este não tem grandes oscilações no fígado.

3- Altos níveis de glicose passam Fosforilase a do estado R para o T (inativo).

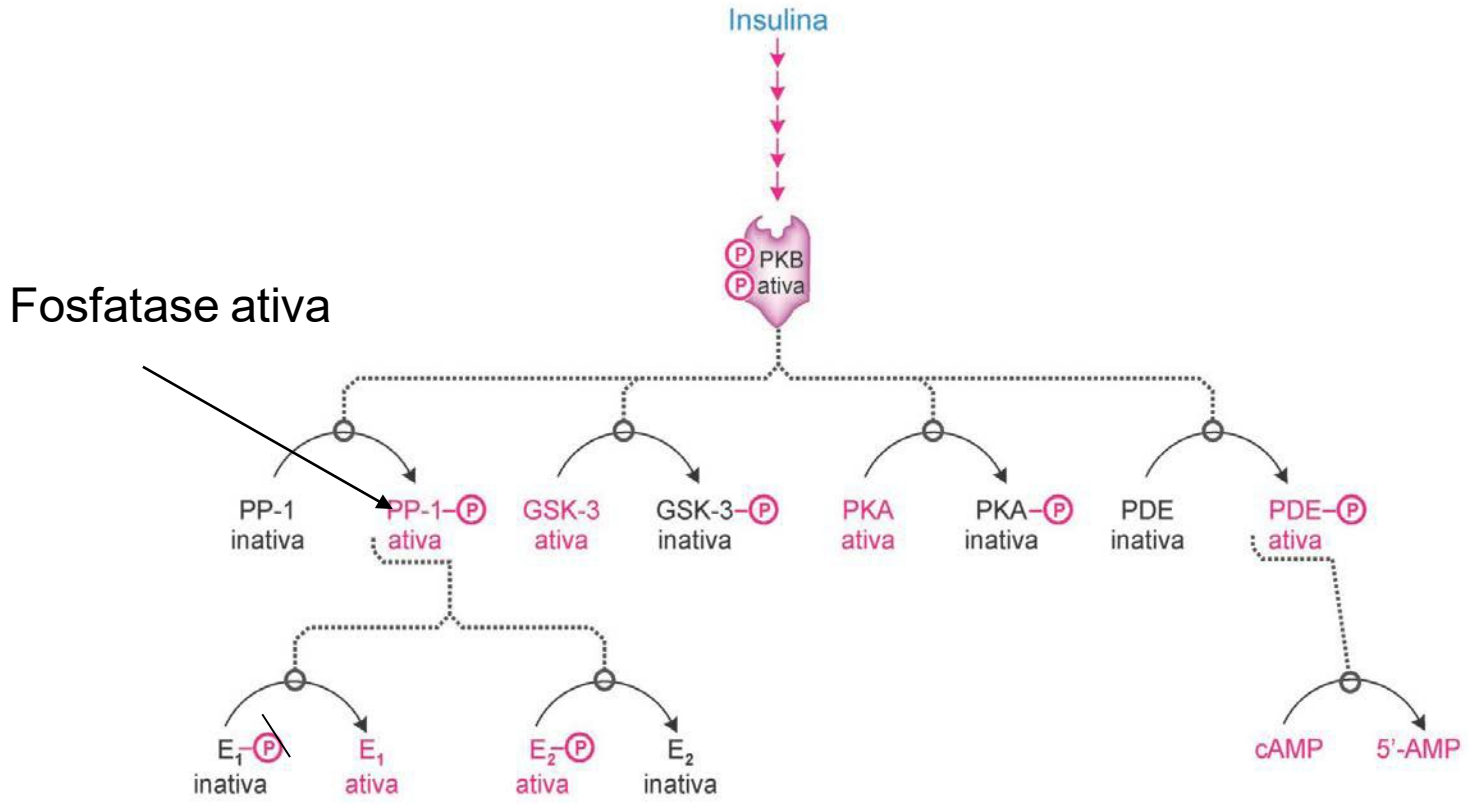
4-Glucagon induz a fosforilação/ ativação da fosforilase a

Glucagon promove a degradação do glicogênio





Regulação do metabolismo do glicogênio

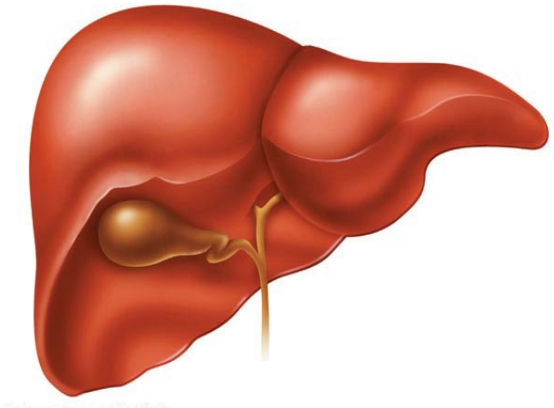


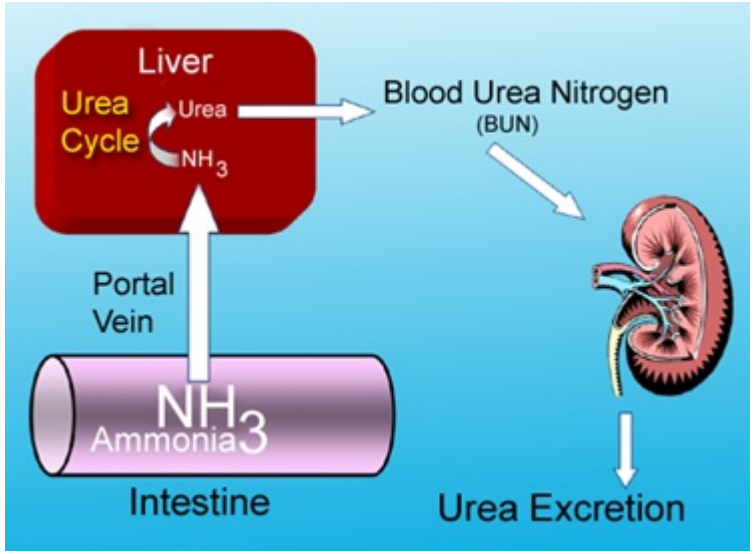
Glicogênio sintase Glicogênio fosforilase

Síntese de glicogênio

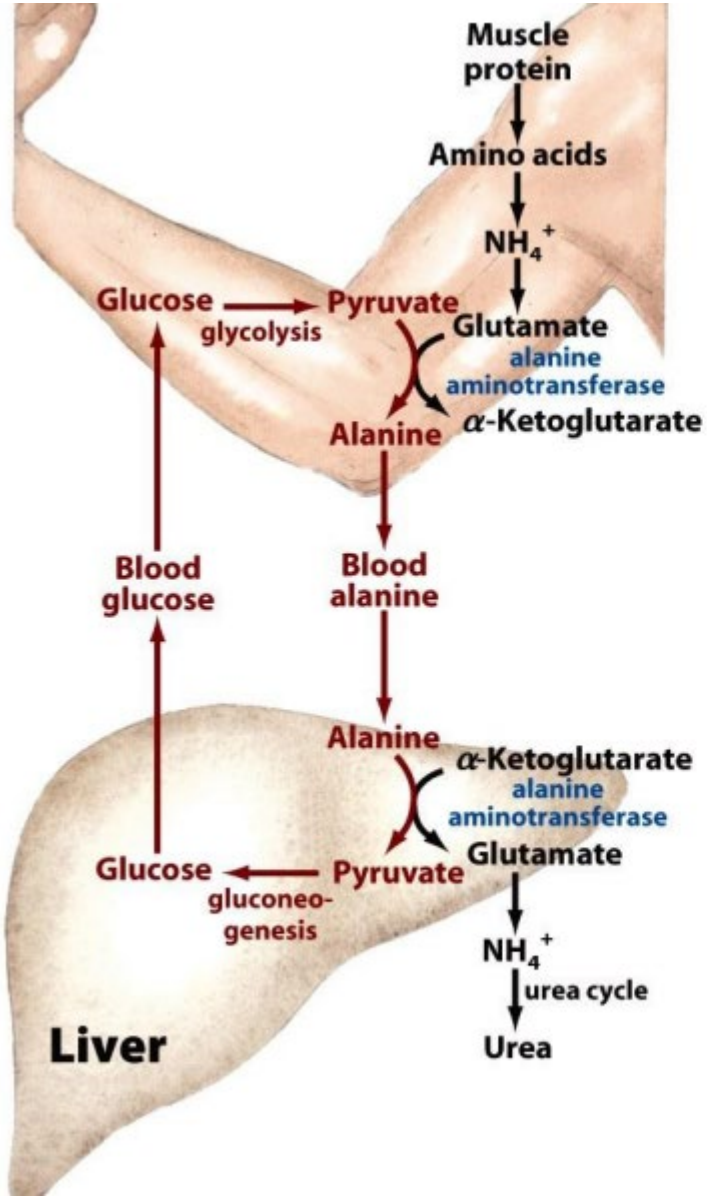
Fígado

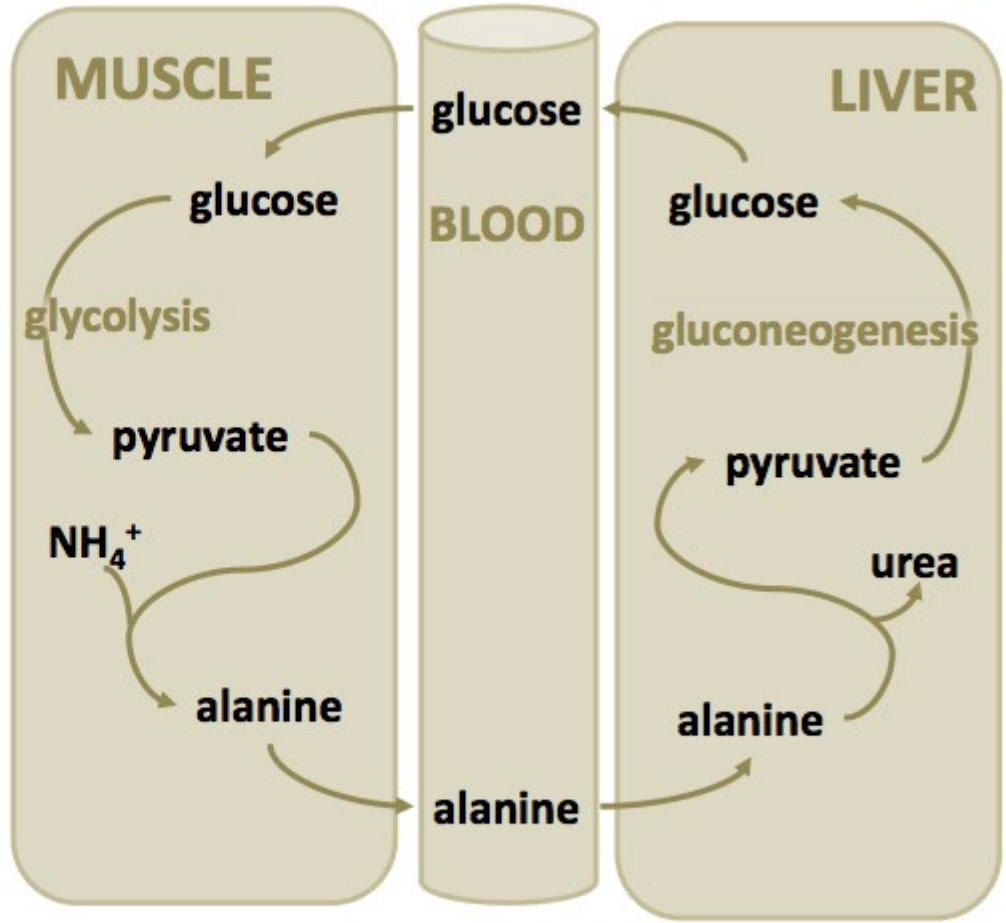
Aminoácidos





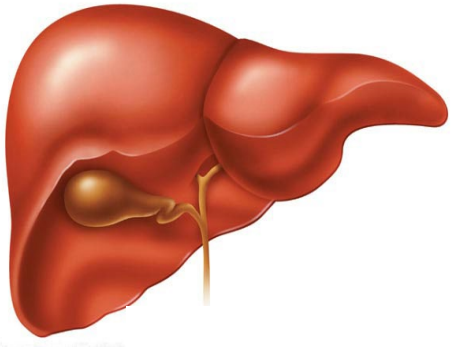
https://binged.it/2A1SbCg


Muscle protein
Amino acids
NH_4^+
Glucose
glycolysis
Pyruvate
Glutamate
alanine aminotransferase
Alanine
α-Ketoglutarate
Blood glucose
Blood alanine
Alanine
α-Ketoglutarate
alanine aminotransferase
Glucose
gluconeo-genesis
Pyruvate
Glutamate
NH_4^+
urea cycle
Urea
Liver


MUSCLE
glucose
glycolysis
pyruvate
NH_4^+
alanine
glucose
BLOOD
alanine
LIVER
glucose
gluconeogenesis
pyruvate
urea
alanine

Aminoácidos

Fígado



Provenientes da dieta:

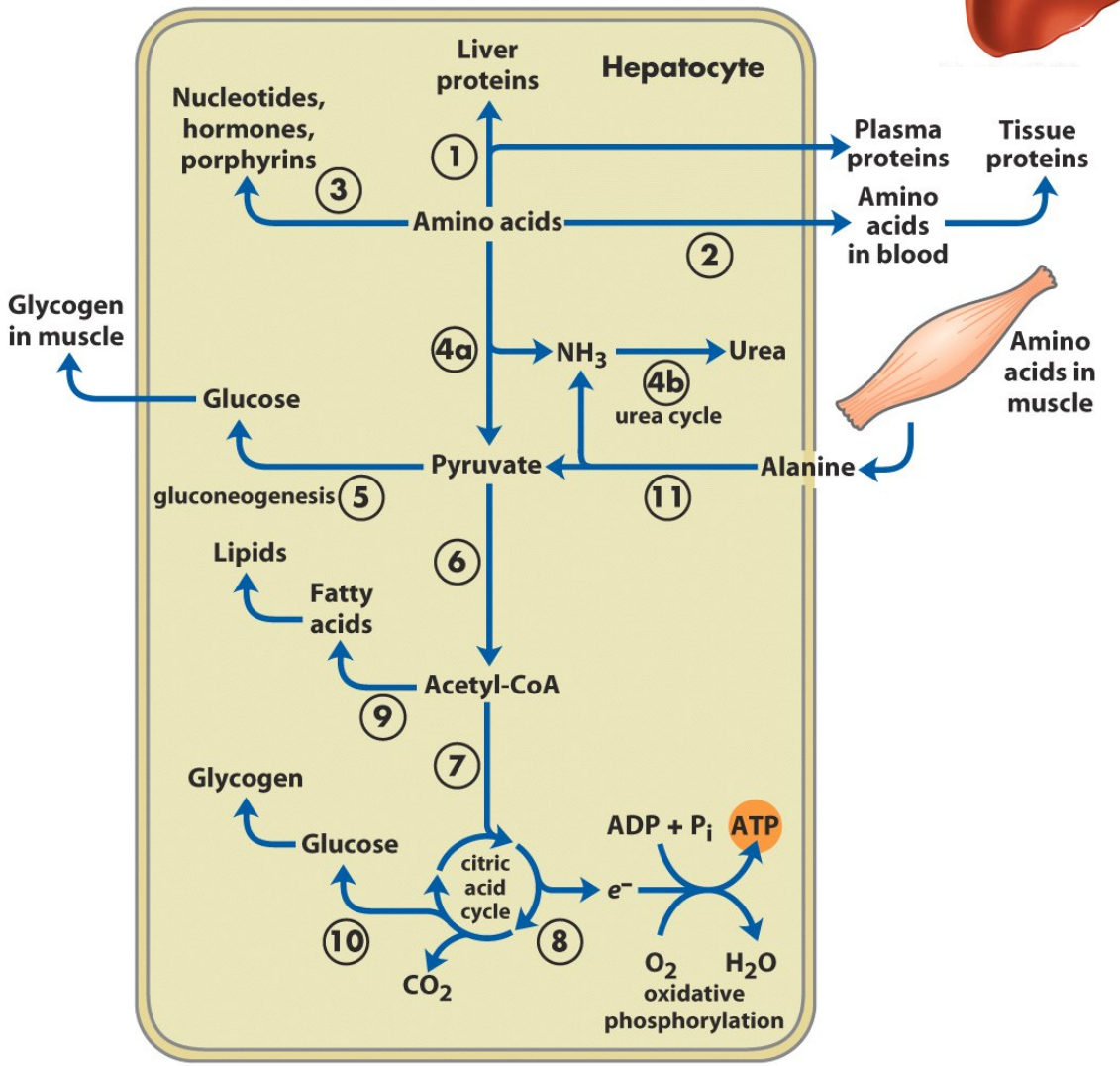
①②③ Síntese de proteínas e derivados

④ Desaminação, síntese TAG

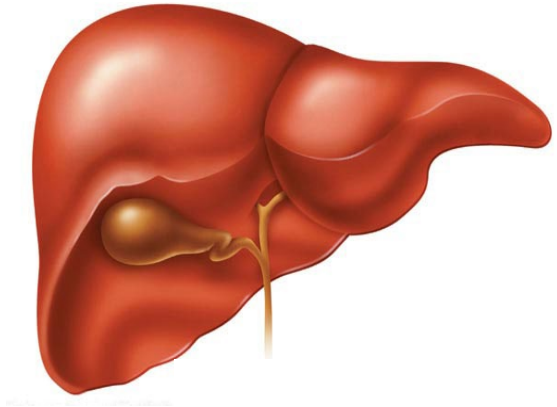
Provenientes do músculo:

④ Desaminação

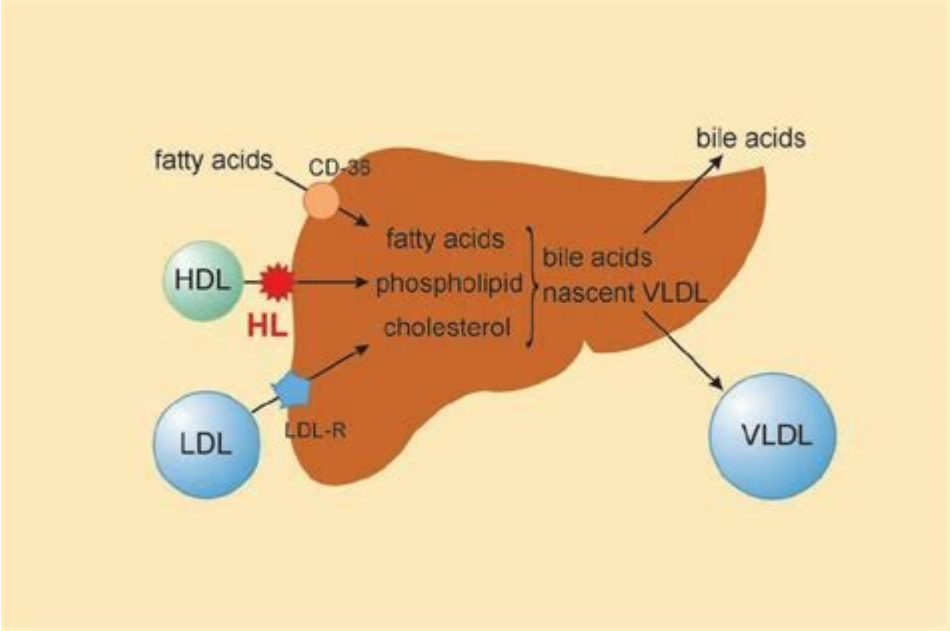
④⑥⑦⑧⑩ Gliconeogênese
Corpos cetônicos



Fígado



Lipídeos



Lipídeos

↑ **insulina:** Síntese ácidos graxos / TAG

Armazena TAG

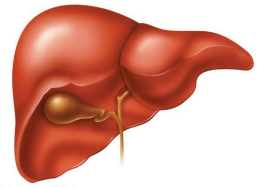
Exporta ácidos graxos e TAG

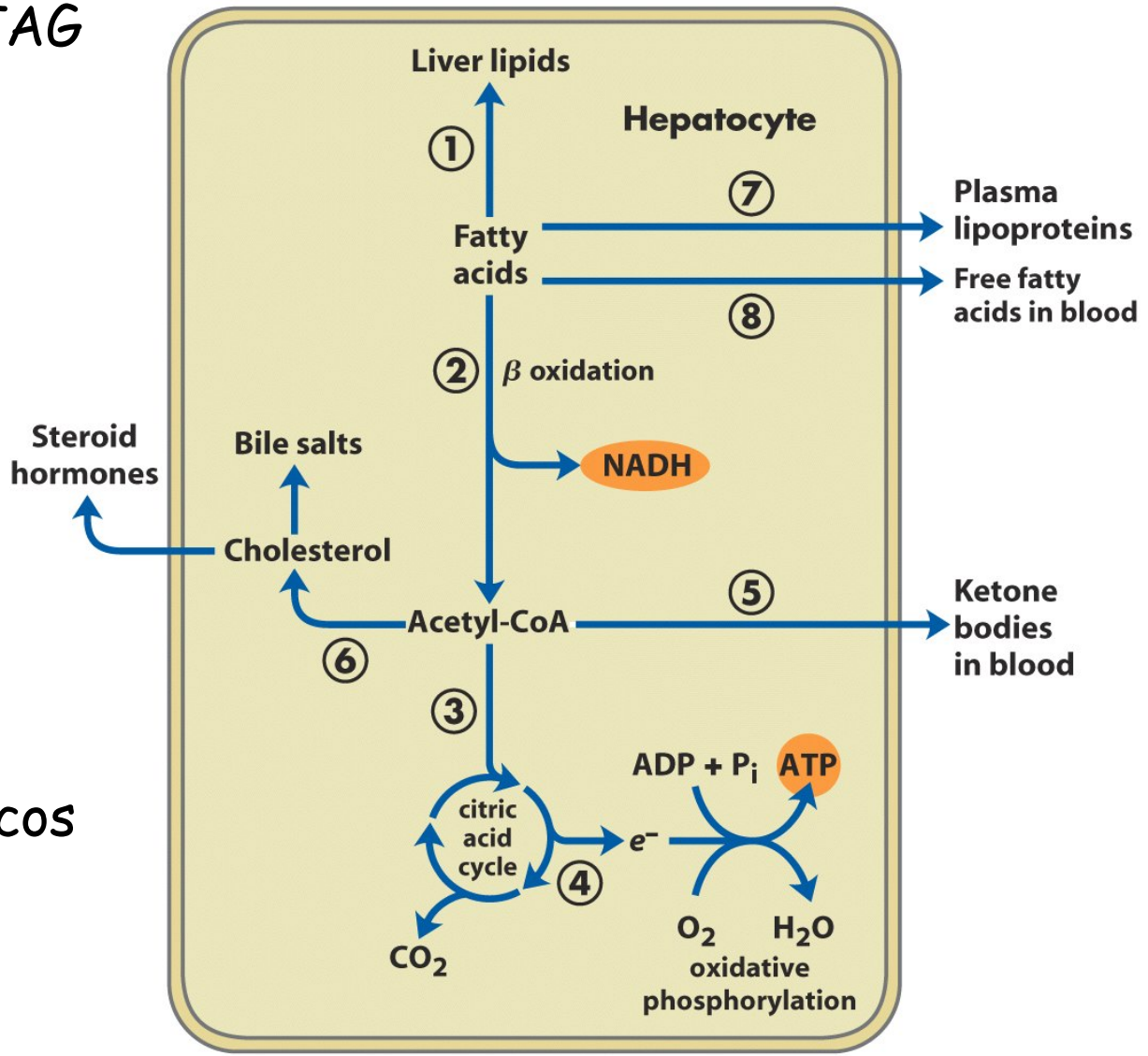
Síntese de colesterol e derivados

↑ **glucagon:**

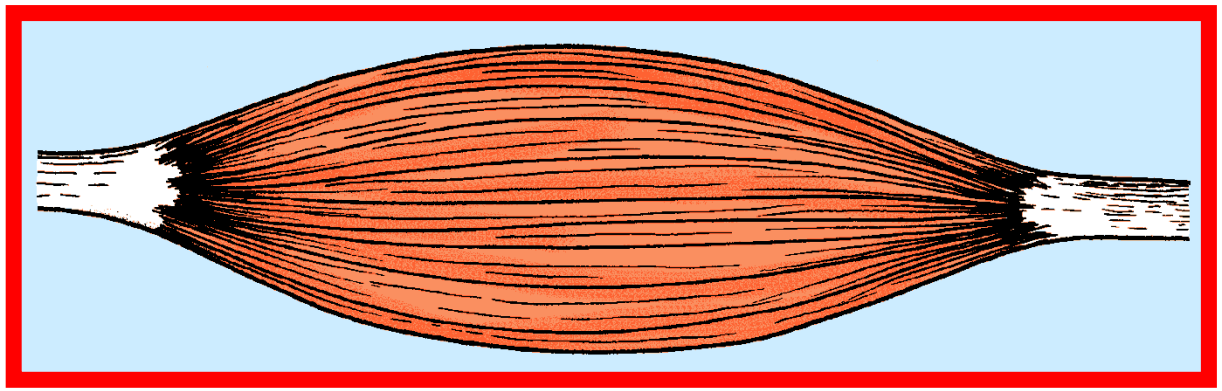
β oxidação - fonte de ATP
- fonte de corpos cetônicos

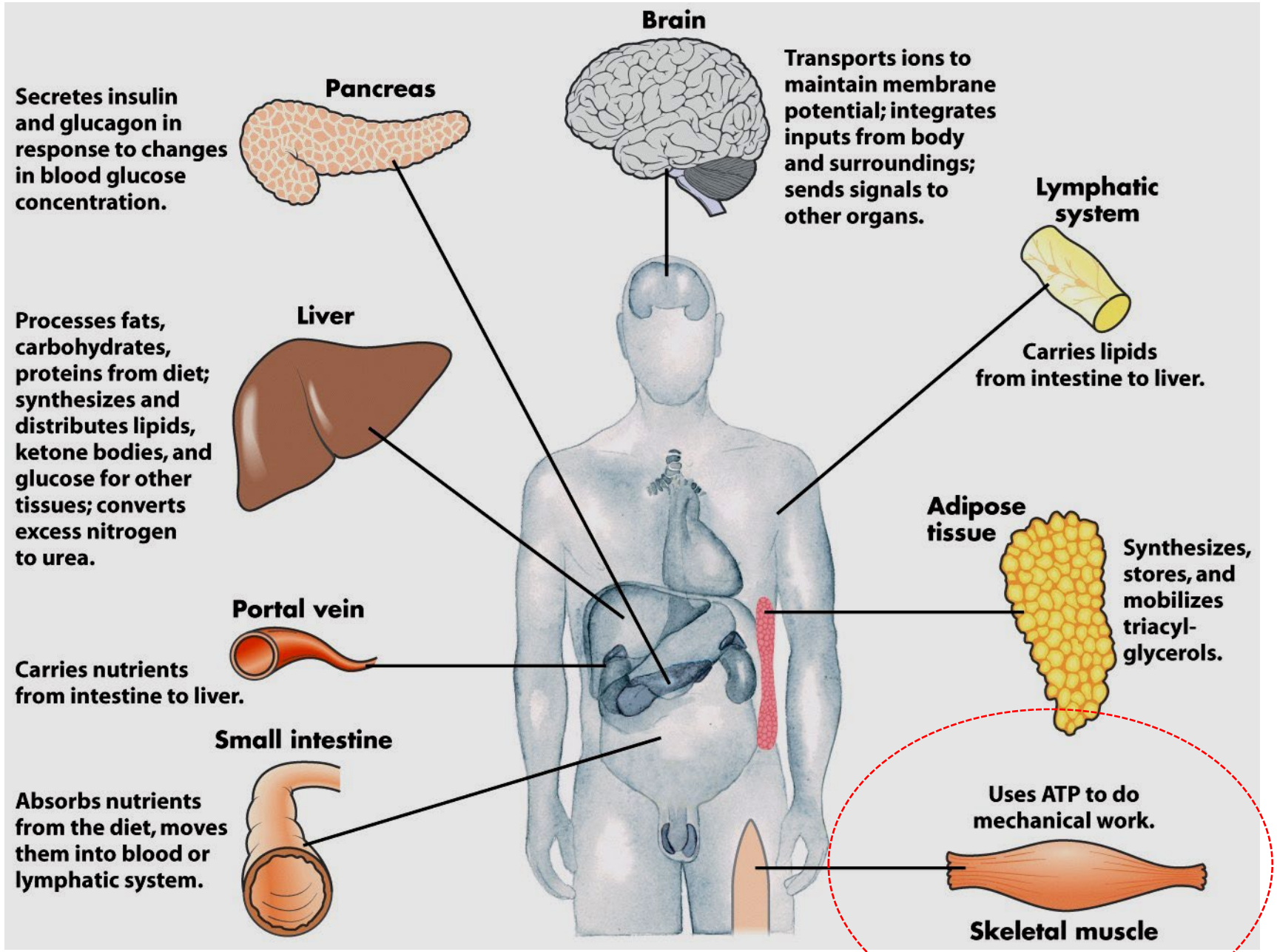
Fígado

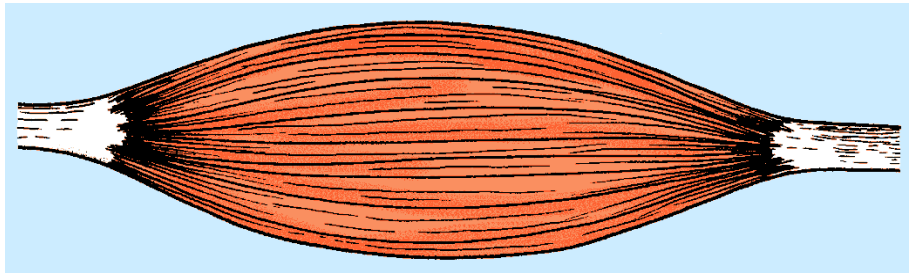




Músculo




Brain
Transports ions to maintain membrane potential; integrates inputs from body and surroundings; sends signals to other organs.
Pancreas
Secretes insulin and glucagon in response to changes in blood glucose concentration.
Lymphatic system
Carries lipids from intestine to liver.
Liver
Processes fats, carbohydrates, proteins from diet; synthesizes and distributes lipids, ketone bodies, and glucose for other tissues; converts excess nitrogen to urea.
Adipose tissue
Synthesizes, stores, and mobilizes triacyl-glycerols.
Portal vein
Carries nutrients from intestine to liver.
Small intestine
Absorbs nutrients from the diet, moves them into blood or lymphatic system.
Uses ATP to do mechanical work.
Skeletal muscle



Regulado pela demanda energética

Principalmente regulada por epinefrina e insulina

Músculo produz energia ou armazena para o seu próprio consumo

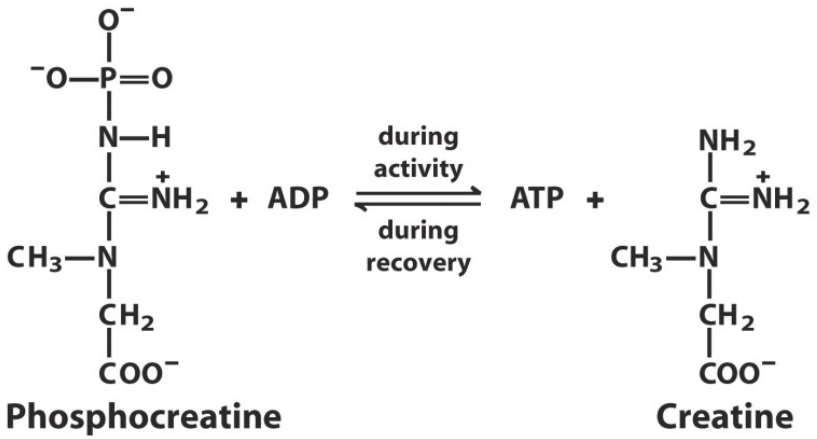
Músculo Esquelético

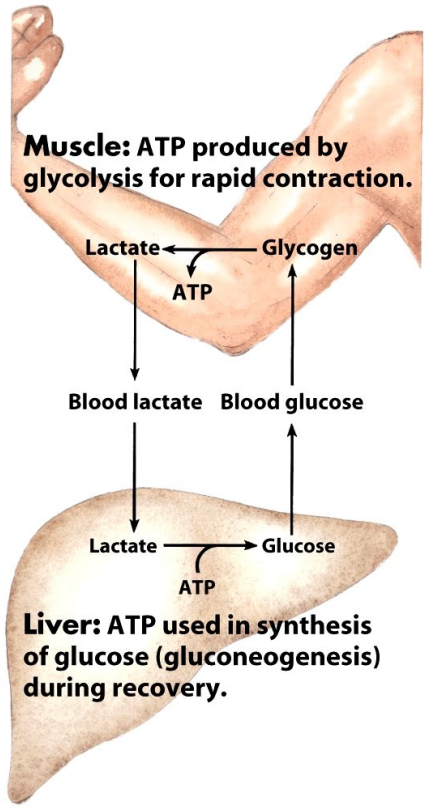
- Tecido especializado em gerar ATP para a contração

- Fibras vermelhas: Ricas em mitocôndrias,
  fazem Fosforilação oxidativa

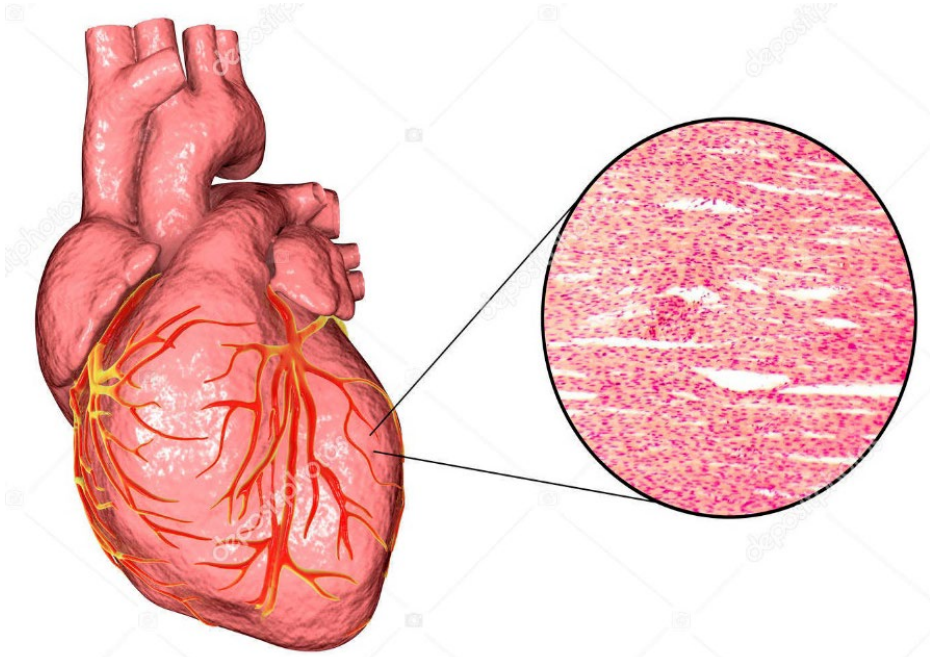
- Fibras brancas: Ricas em glicogênio,
  fermentam por anaerobiose relativa

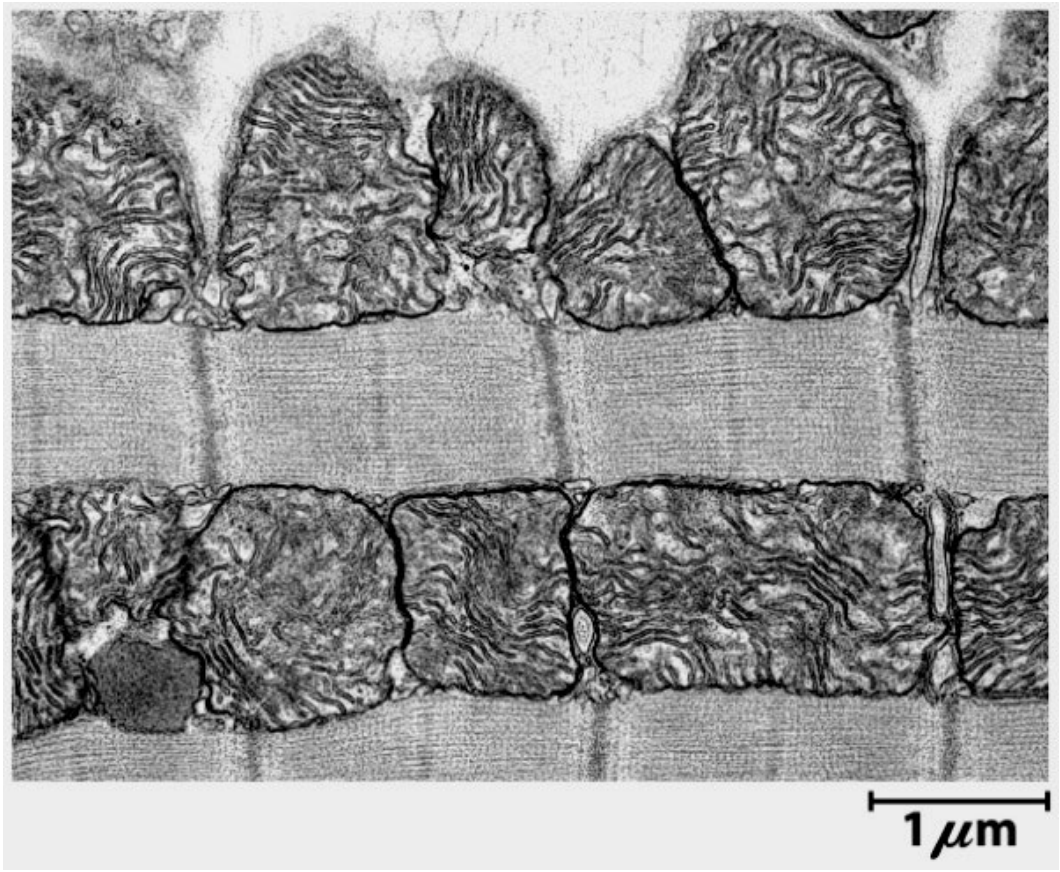
- Armazenam fosfocreatina

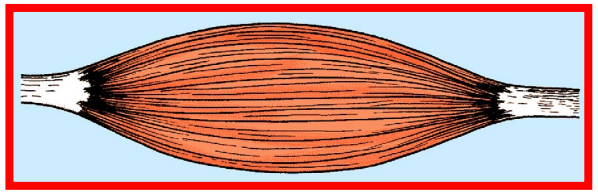




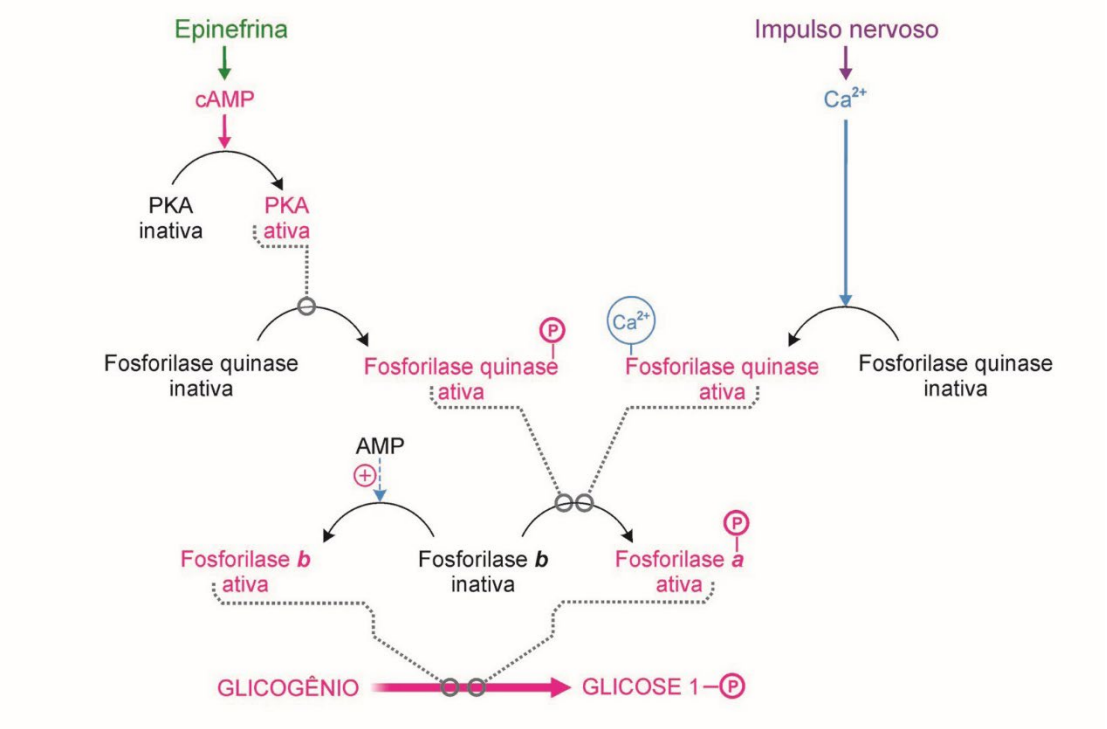
Músculo Cardíaco



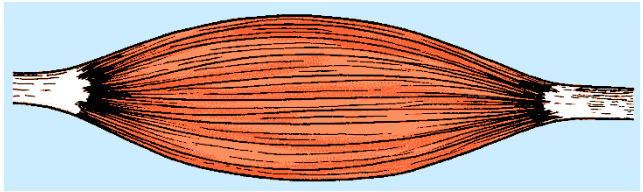




Regulação da degradação do glicogênio muscular
Ativação da glicogênio fosforilase



Glicogênio Fosforilase Muscular



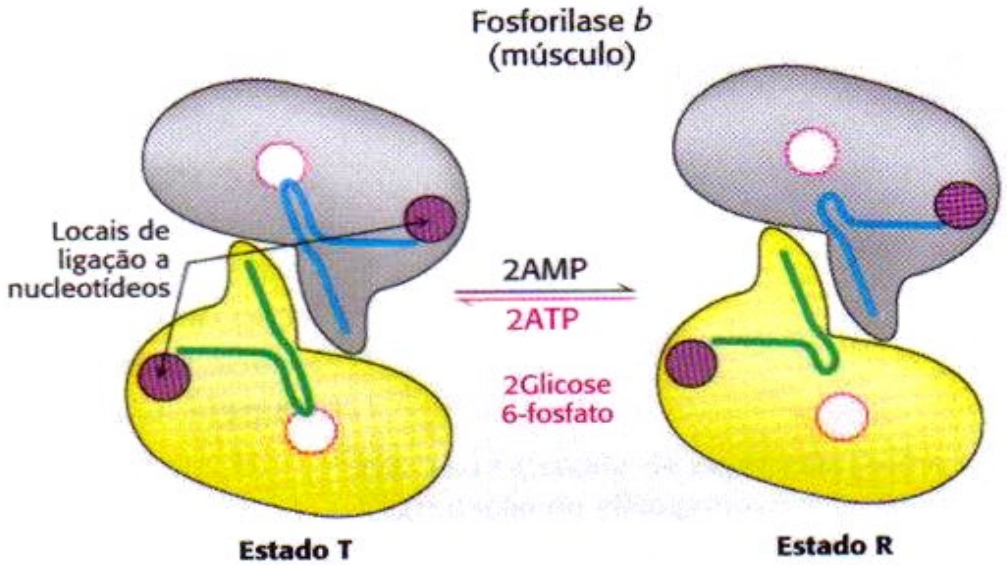
Epinefrina

↓

Fosforilação da fosforilase

↓

Fosforilase **a**



Exercicio

↓

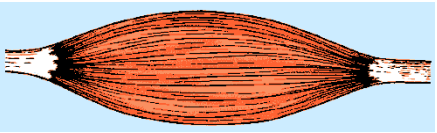
[AMP] ⬆

↓

Ativação da fosforilase

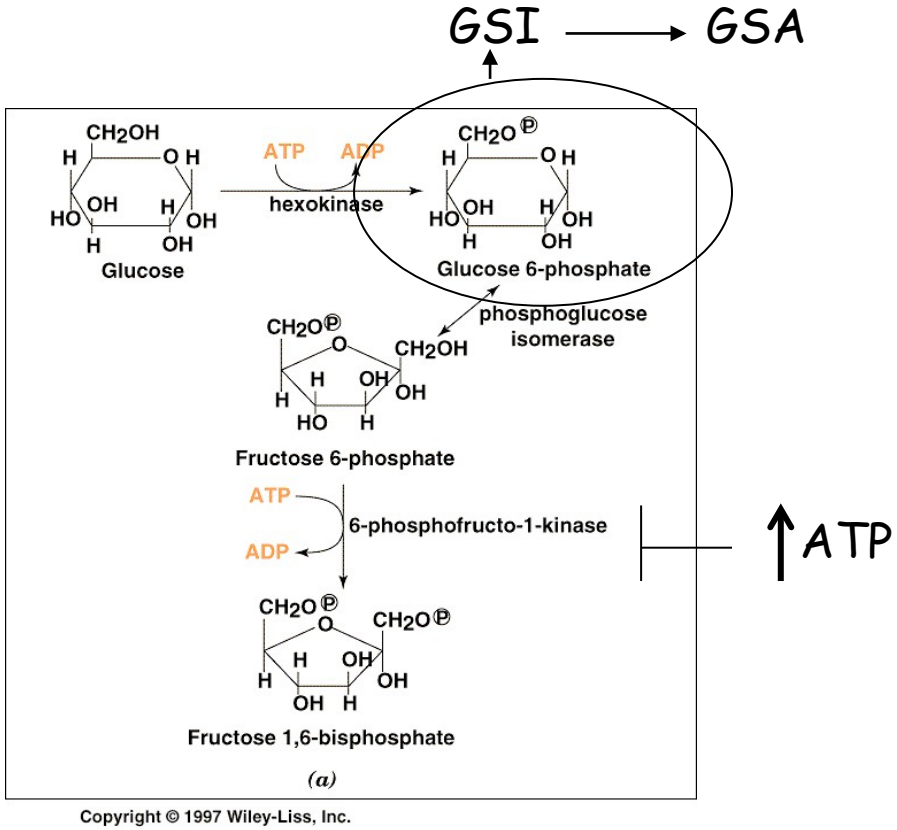
-Glicose-6-fosfato, ATP favorecem estado T (tenso, menos ativo), AMP favorece estado R da fosforilase b por alosteria

-Ausência de glicose 6-fosfatase no músculo assegura que a glicose 6-fosfato derivada do glicogênio permaneça na célula para a formação de energia.

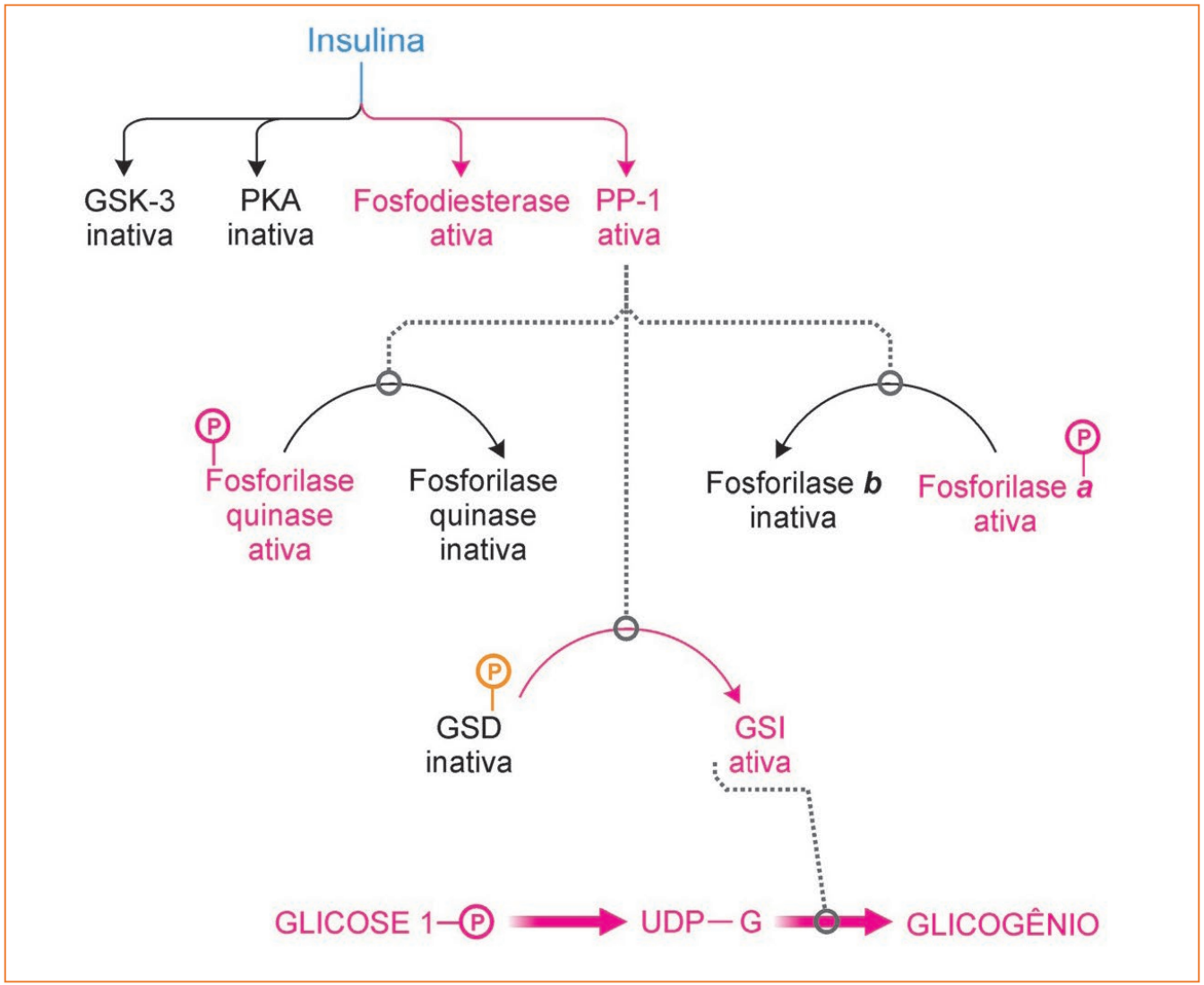


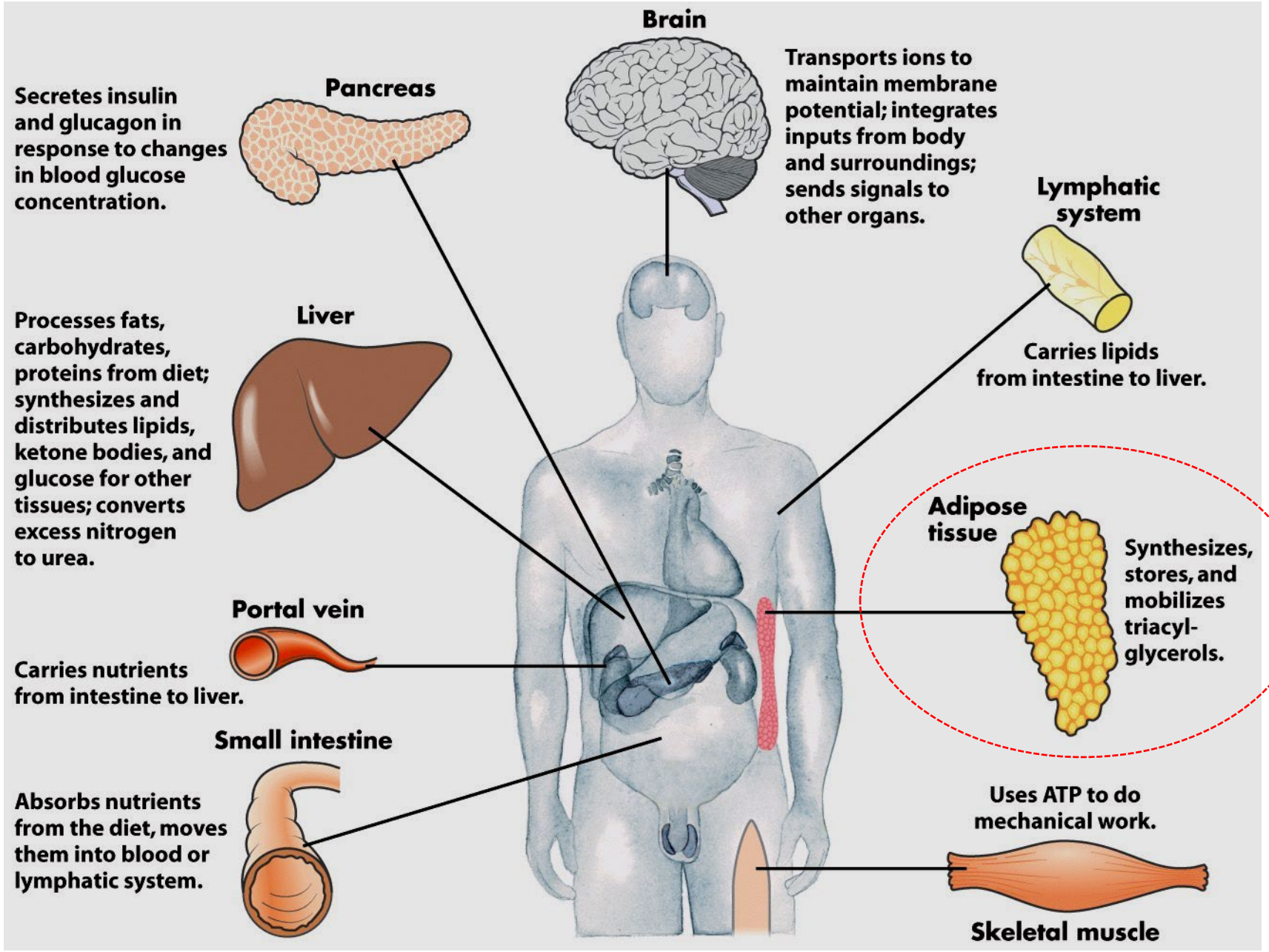
Regulações alostéricas da glicogênio sintase

Fosfofruto quinase inibida aumenta a concentração de **glicose 6-fosfato** que ativa a glicogênio sintase promovendo a síntese de glicogênio.

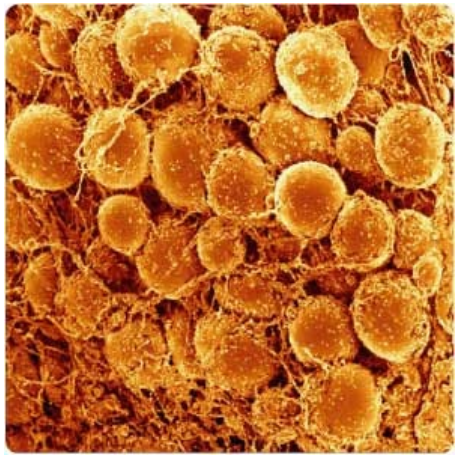


Insulina promove a síntese do glicogênio




Brain
Transports ions to maintain membrane potential; integrates inputs from body and surroundings; sends signals to other organs.
Pancreas
Secretes insulin and glucagon in response to changes in blood glucose concentration.
Lymphatic system
Carries lipids from intestine to liver.
Liver
Processes fats, carbohydrates, proteins from diet; synthesizes and distributes lipids, ketone bodies, and glucose for other tissues; converts excess nitrogen to urea.
Adipose tissue
Synthesizes, stores, and mobilizes triacyl-glycerols.
Portal vein
Carries nutrients from intestine to liver.
Small intestine
Absorbs nutrients from the diet, moves them into blood or lymphatic system.
Uses ATP to do mechanical work.
Skeletal muscle

Tecido Adiposo

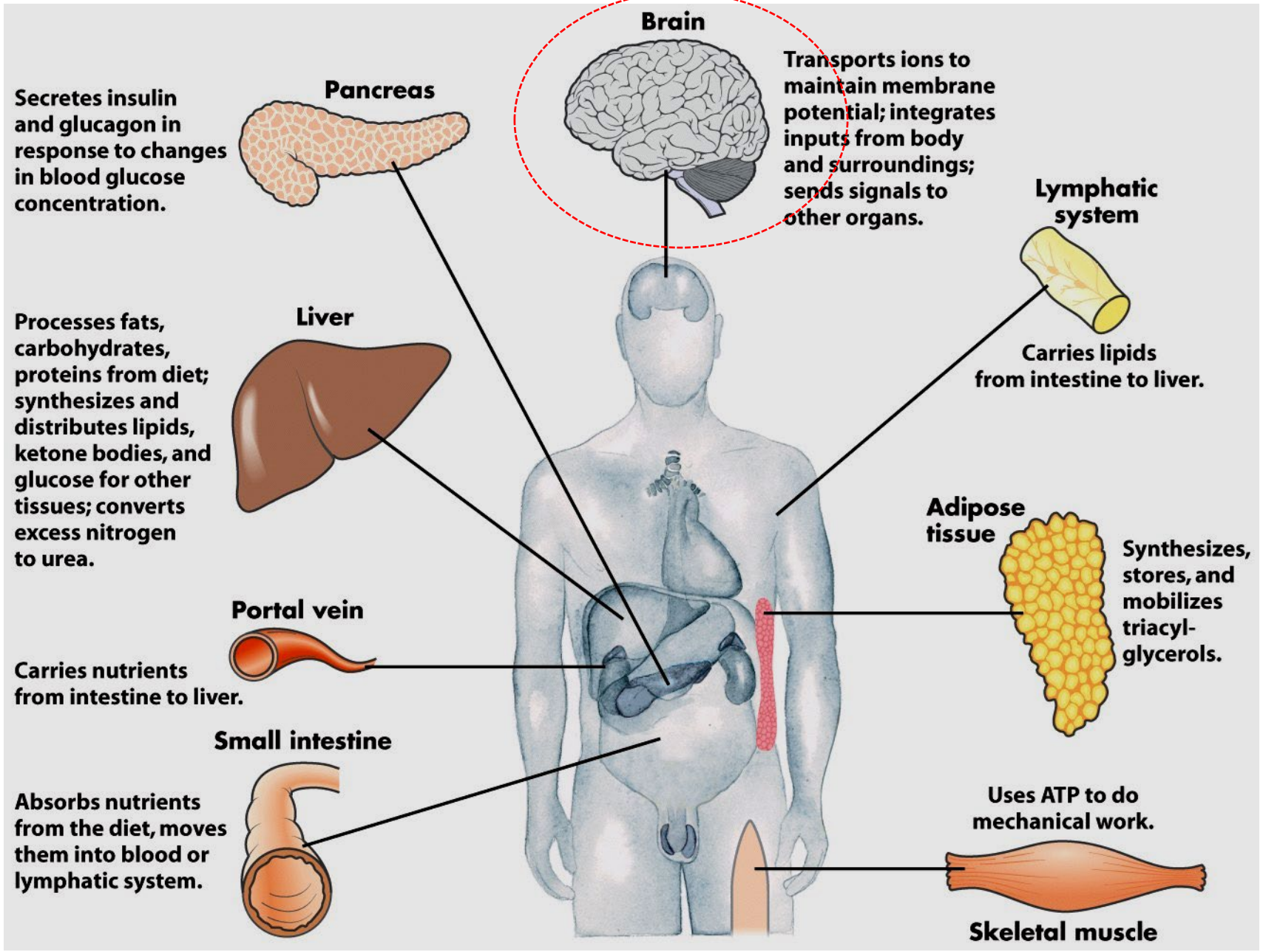


- Glicólise estimulada por insulina → citrato → TAG

- Acumula ácidos graxos e TAG sintetizados no fígado e absorvidos no TGI

- ↑ glucagon/adrenalina: ↑ lipase, exportação de ácidos graxos

- Tecido adiposo marrom: rico em mitocôndrias
  rico em UCP1


Brain
Transports ions to maintain membrane potential; integrates inputs from body and surroundings; sends signals to other organs.
Pancreas
Secretes insulin and glucagon in response to changes in blood glucose concentration.
Lymphatic system
Carries lipids from intestine to liver.
Liver
Processes fats, carbohydrates, proteins from diet; synthesizes and distributes lipids, ketone bodies, and glucose for other tissues; converts excess nitrogen to urea.
Adipose tissue
Synthesizes, stores, and mobilizes triacyl-glycerols.
Portal vein
Carries nutrients from intestine to liver.
Small intestine
Absorbs nutrients from the diet, moves them into blood or lymphatic system.
Uses ATP to do mechanical work.
Skeletal muscle

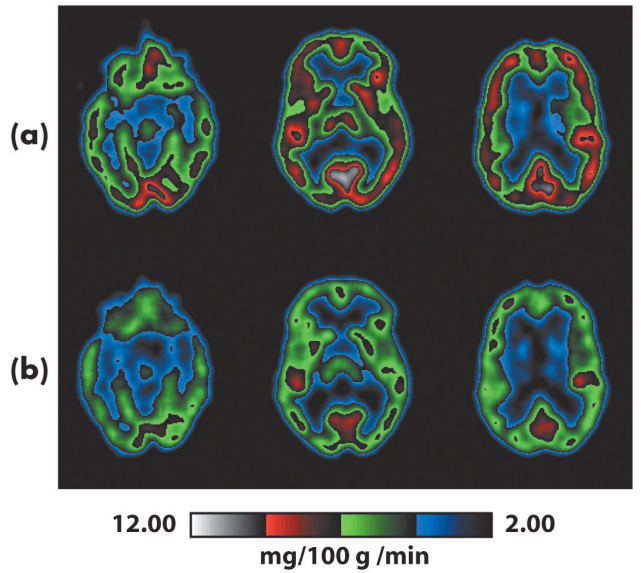
Cérebro

- Neurônios utilizam glicose como substrato (corpos cetônicos em jejum prolongado)

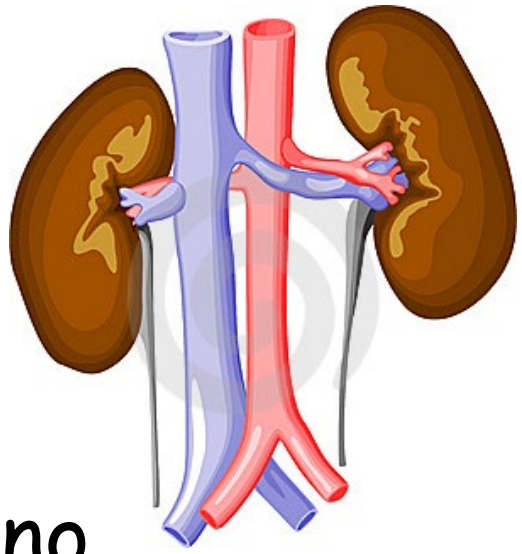
- Glia pode usar ácidos graxos como substrato

- Alto metabolismo oxidativo (20% do oxigênio consumido em repouso)

- PET: consumo de glicose marcada indica áreas de atividade

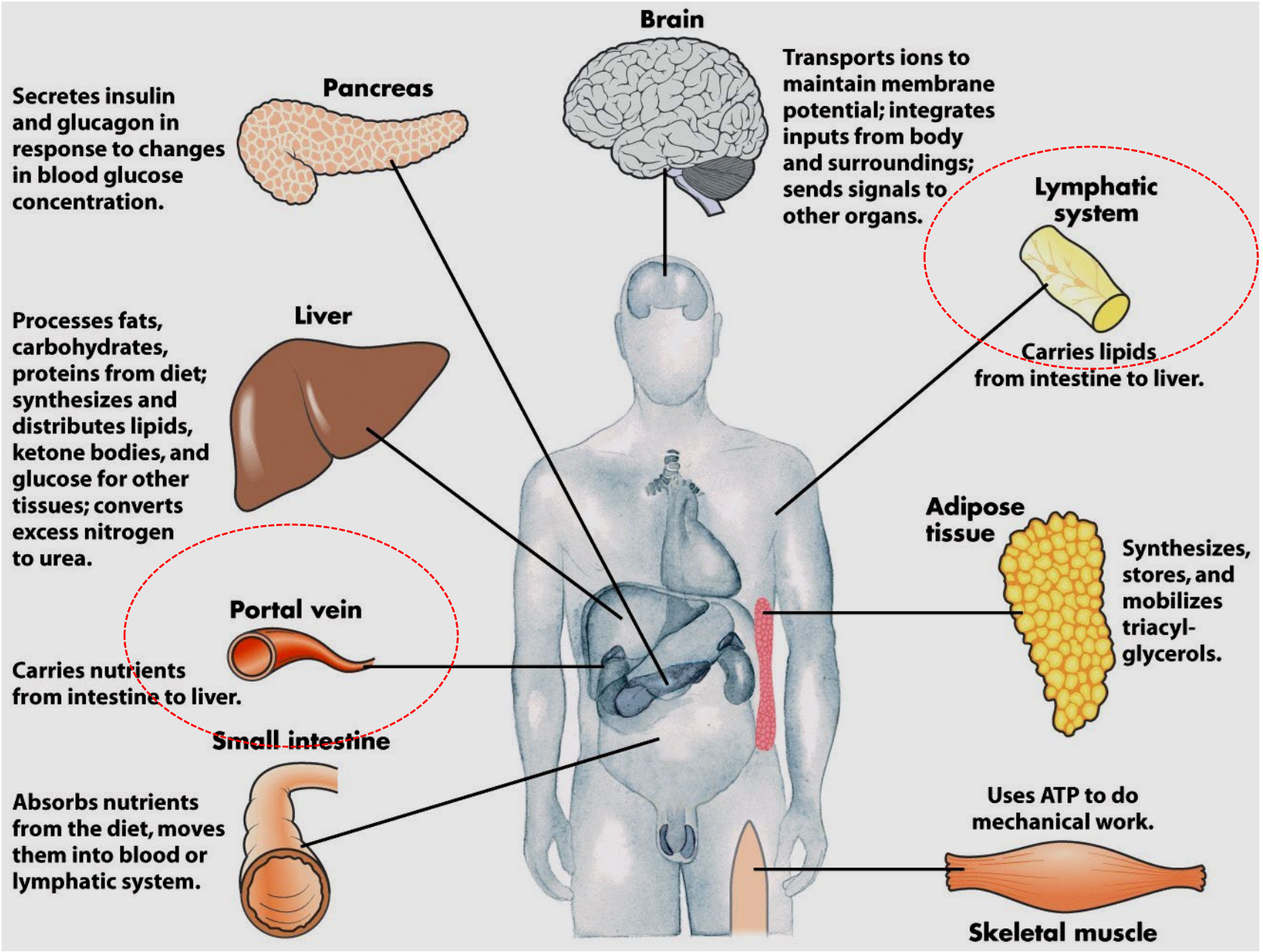


Rins

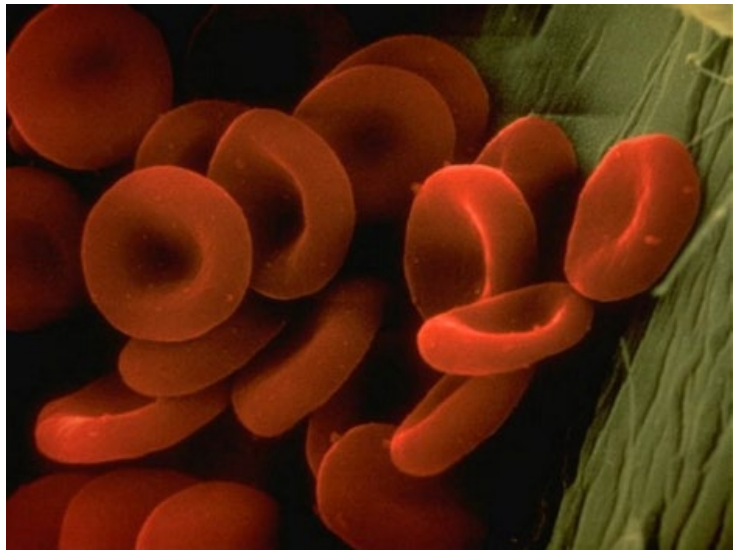


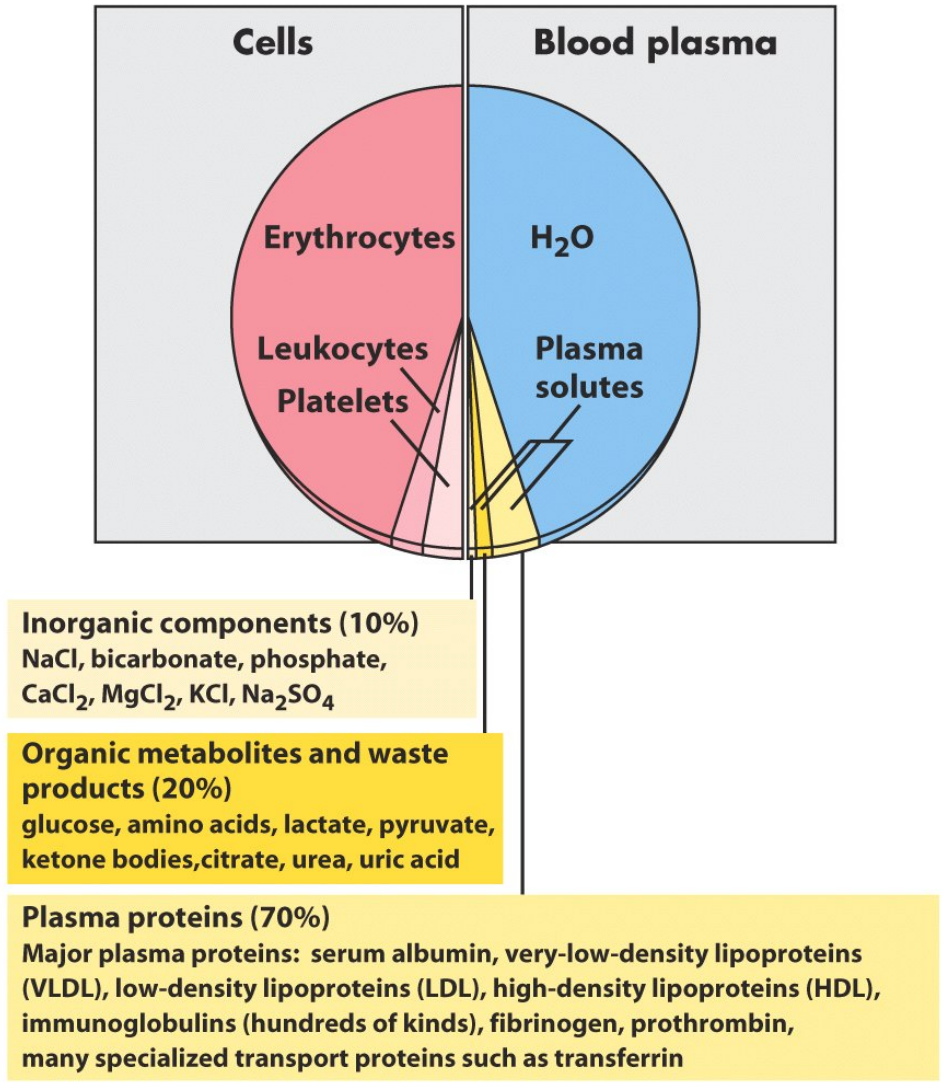
- Removem uréia produzida no fígado

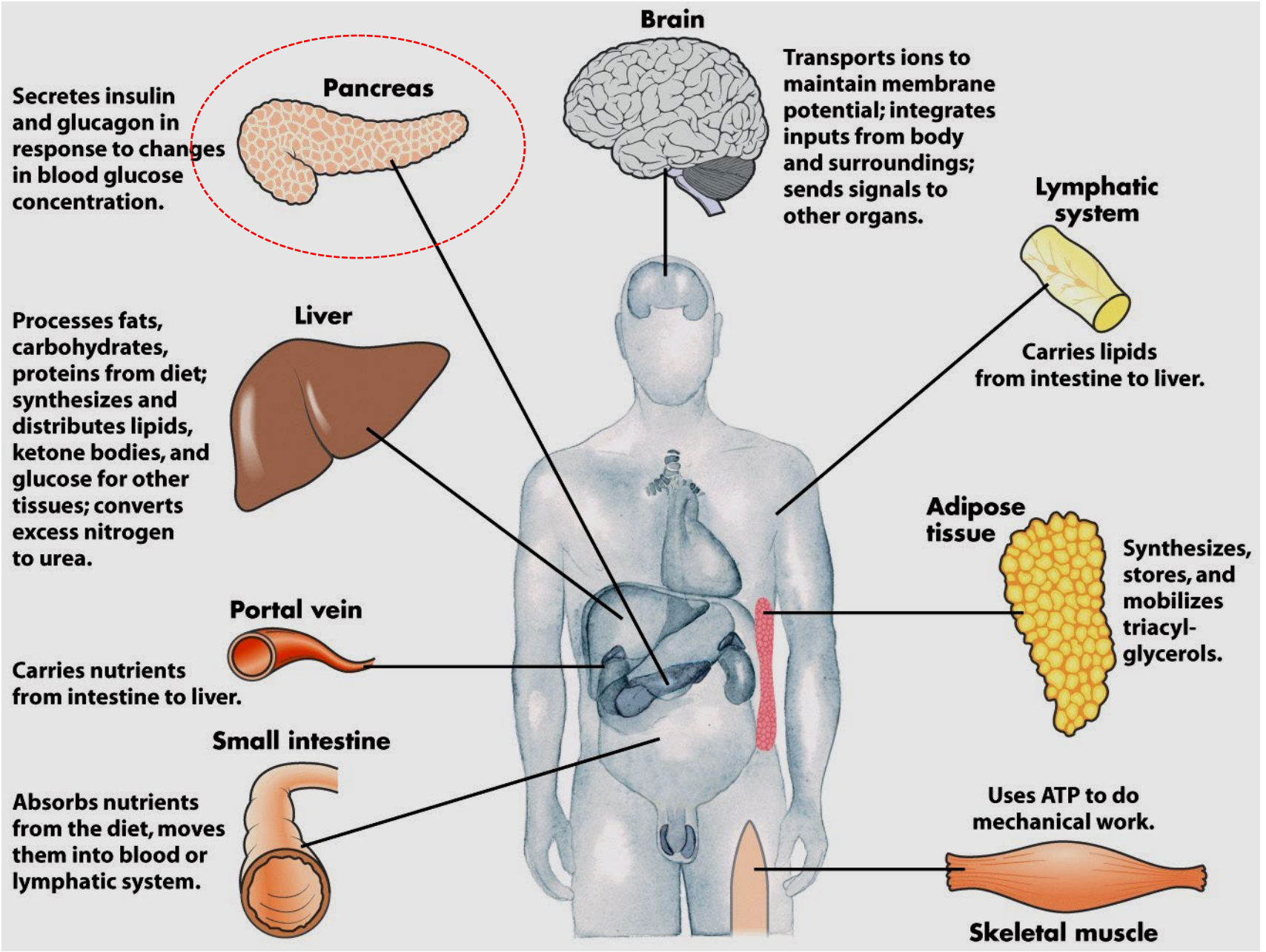
- Fazem gliconeogênese (possuem glicose 6 fosfatase)


Brain
Transports ions to maintain membrane potential; integrates inputs from body and surroundings; sends signals to other organs.
Pancreas
Secretes insulin and glucagon in response to changes in blood glucose concentration.
Lymphatic system
Carries lipids from intestine to liver.
Liver
Processes fats, carbohydrates, proteins from diet; synthesizes and distributes lipids, ketone bodies, and glucose for other tissues; converts excess nitrogen to urea.
Adipose tissue
Synthesizes, stores, and mobilizes triacyl-glycerols.
Portal vein
Carries nutrients from intestine to liver.
Small intestine
Absorbs nutrients from the diet, moves them into blood or lymphatic system.
Uses ATP to do mechanical work.
Skeletal muscle

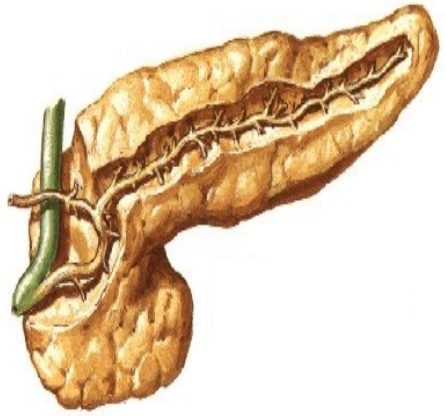
Sangue




Cells
Blood plasma
Erythrocytes
H_2O
Leukocytes
Platelets
Plasma solutes
Inorganic components (10%)
NaCl, bicarbonate, phosphate,
$CaCl_2$, $MgCl_2$, KCl, Na_2SO_4
Organic metabolites and waste products (20%)
glucose, amino acids, lactate, pyruvate, ketone bodies,citrate, urea, uric acid
Plasma proteins (70%)
Major plasma proteins: serum albumin, very-low-density lipoproteins (VLDL), low-density lipoproteins (LDL), high-density lipoproteins (HDL), immunoglobulins (hundreds of kinds), fibrinogen, prothrombin, many specialized transport proteins such as transferrin


Brain
Transports ions to maintain membrane potential; integrates inputs from body and surroundings; sends signals to other organs.
Pancreas
Secretes insulin and glucagon in response to changes in blood glucose concentration.
Lymphatic system
Carries lipids from intestine to liver.
Liver
Processes fats, carbohydrates, proteins from diet; synthesizes and distributes lipids, ketone bodies, and glucose for other tissues; converts excess nitrogen to urea.
Adipose tissue
Synthesizes, stores, and mobilizes triacyl-glycerols.
Portal vein
Carries nutrients from intestine to liver.
Small intestine
Absorbs nutrients from the diet, moves them into blood or lymphatic system.
Uses ATP to do mechanical work.
Skeletal muscle

Pâncreas



- Função exócrina: Secreção de enzimas líticas

- Função endócrina (ilhotas): secreção de insulina e glucagon

- Células α: Secretam glucagon em resposta a ↓ glicemia, ↑ AA, ↑ adrenalina

- Células β: Secretam insulina em resposta a ↑ glicemia
  Possuem GLUT2 e glicoquinase