

Le métabolisme et les fonctions des glucides

L'HOMOPOLYSACCHARIDE DE L'HOMME ET DES ANIMAUX



**LE
GLYCOGENE**

**LES HOMOPOLYSACCHARIDES DES
PLANTES**

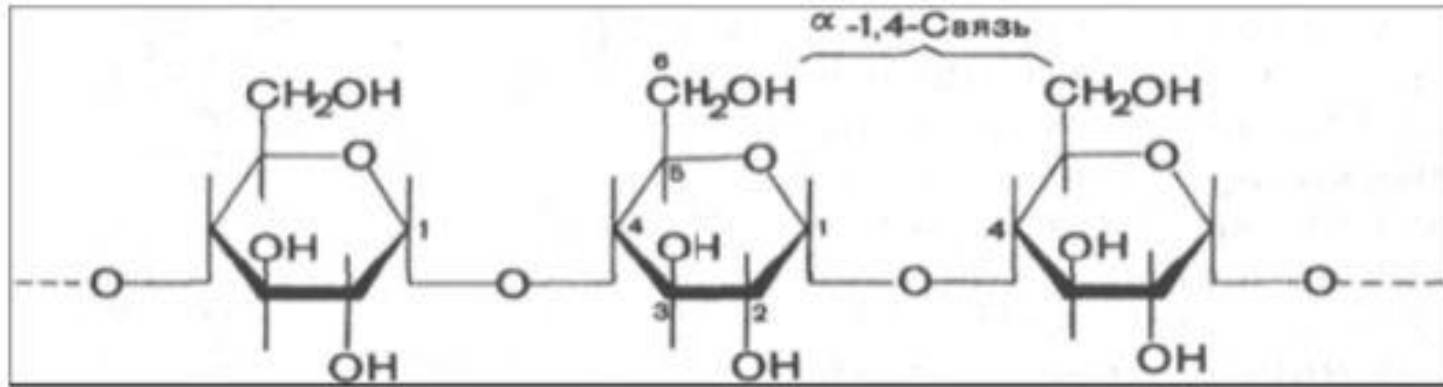


L'AMIDON

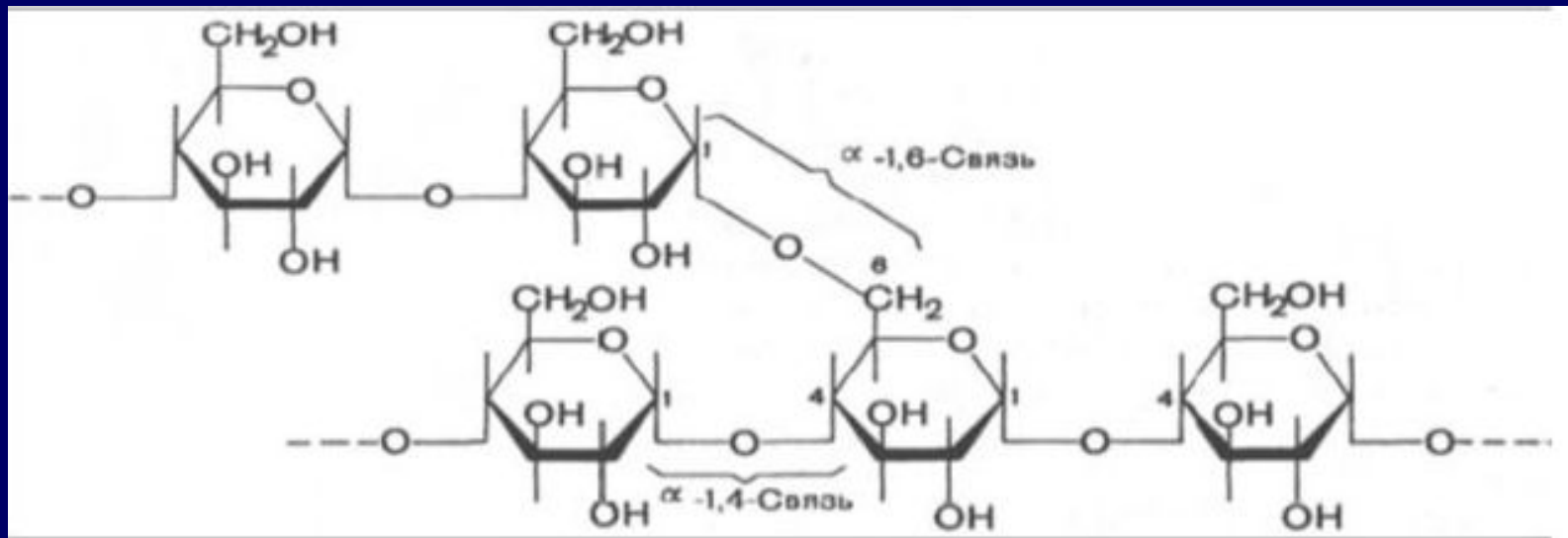


LA CELLULOSE

L'AMIDON

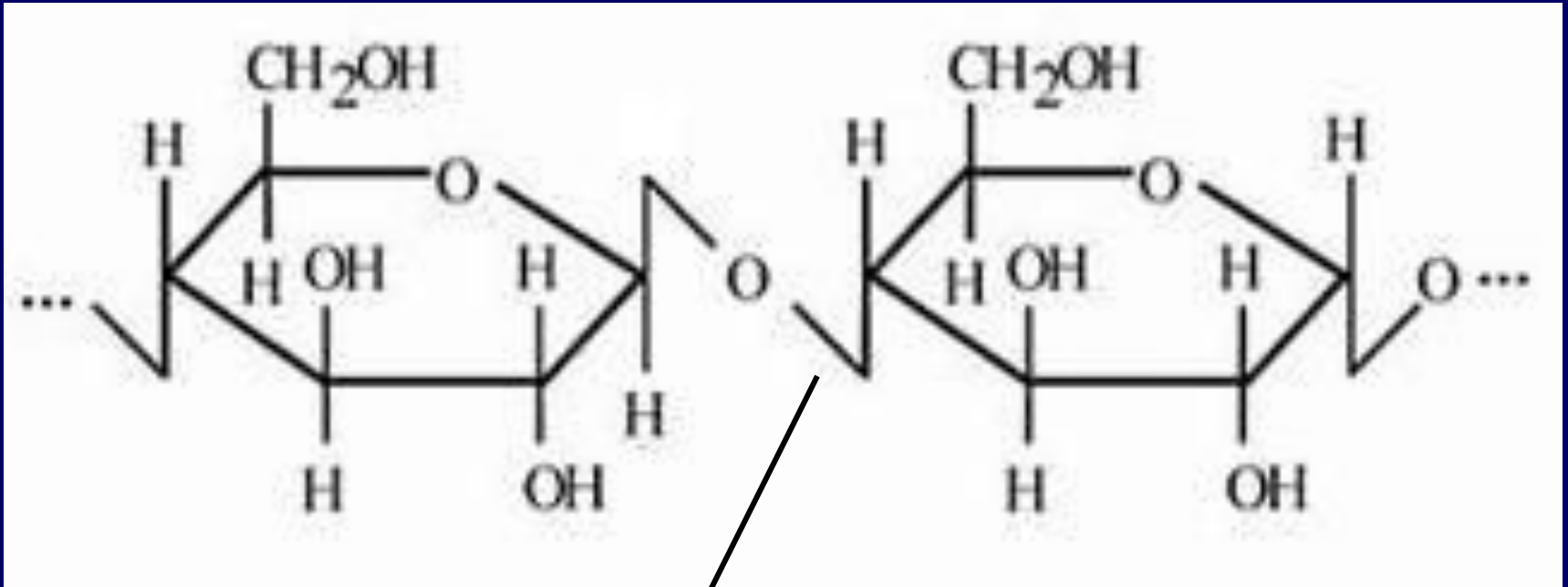


Участок молекулы амилозы



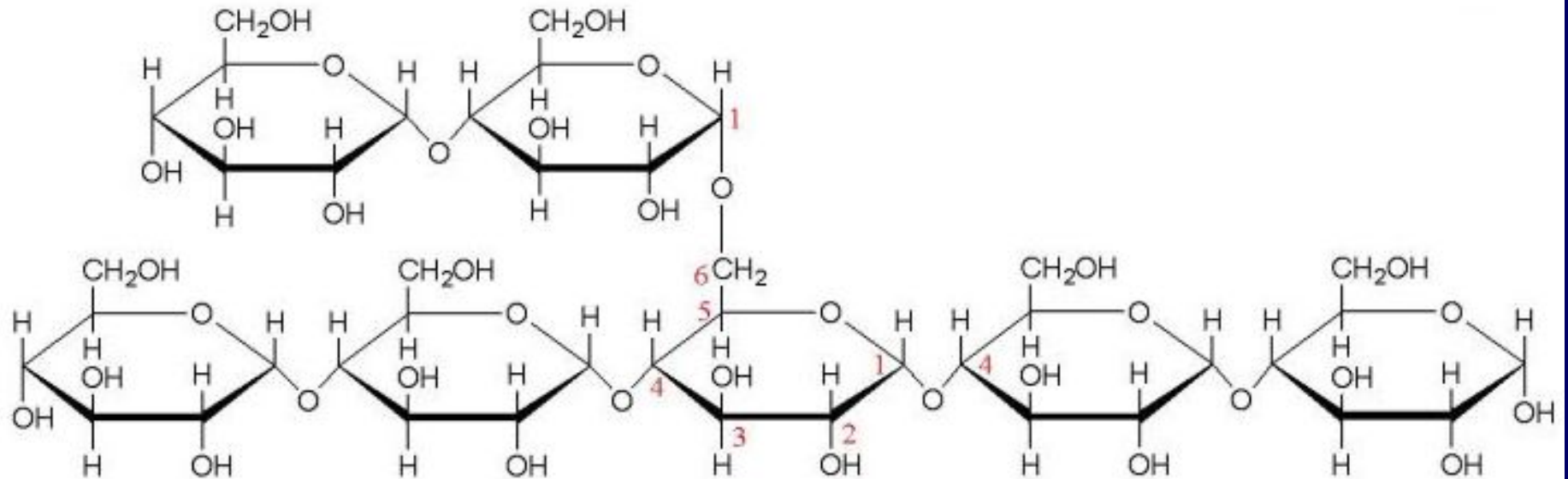
Участок молекулы амилопектина

LA CELLULOSE



la liaison β - 1, 4 glycosidique

LE GLYCOGENE

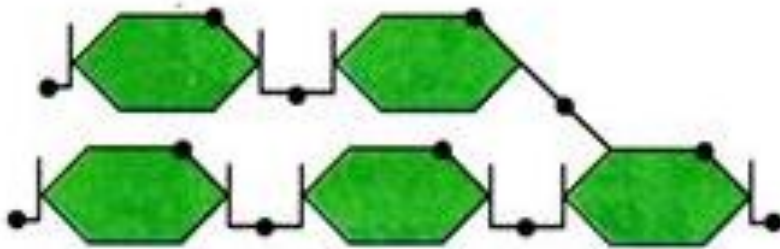
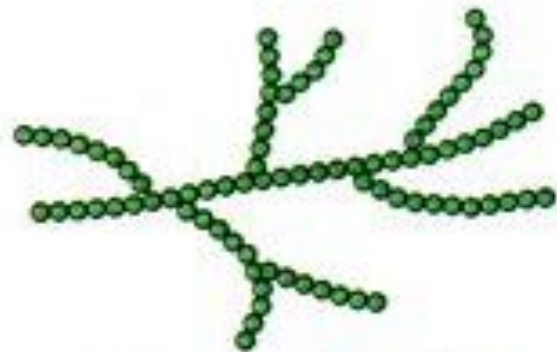




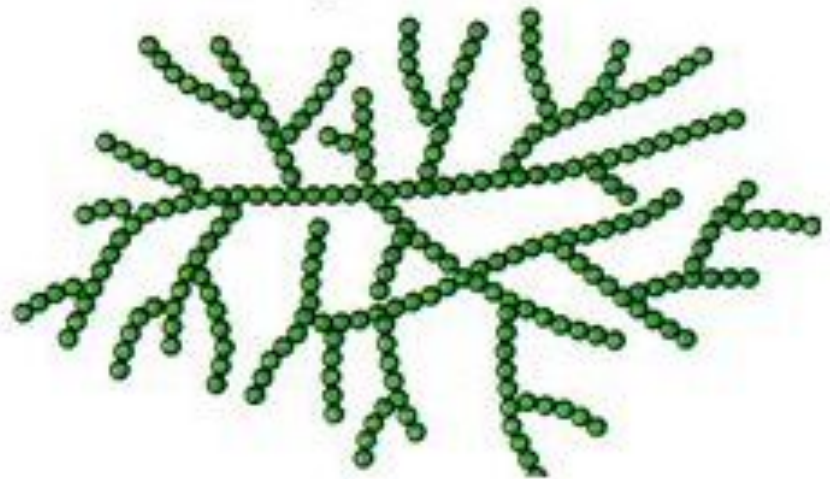
Целлюлоза



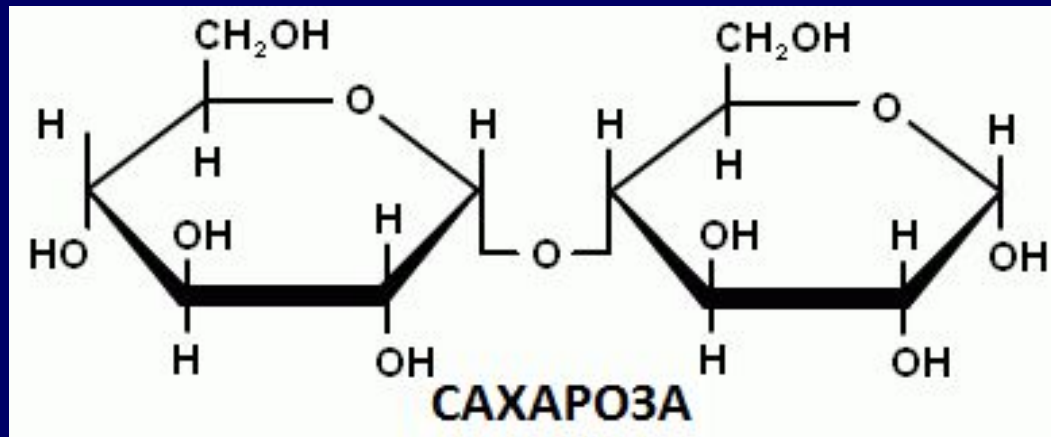
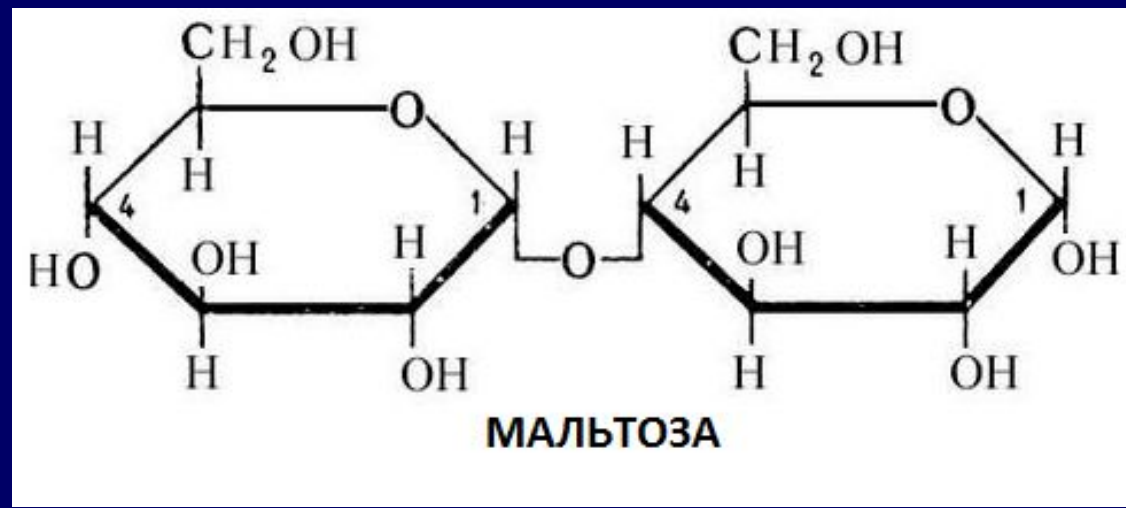
Крахмал



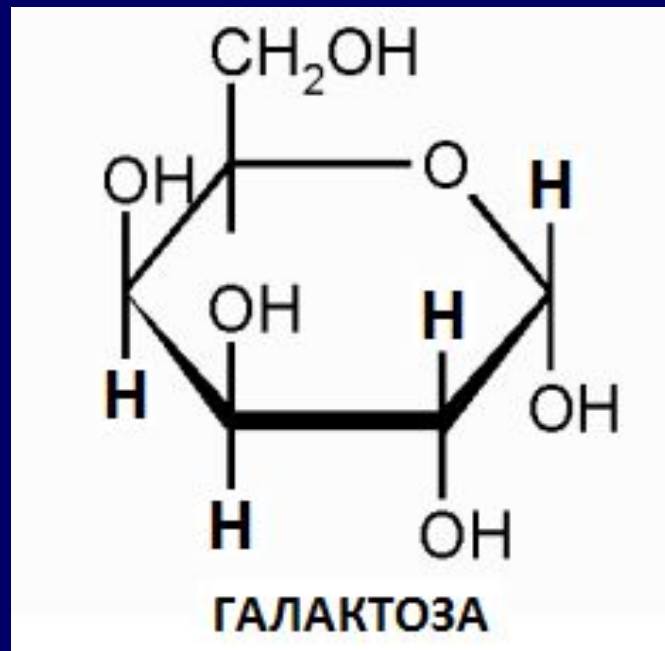
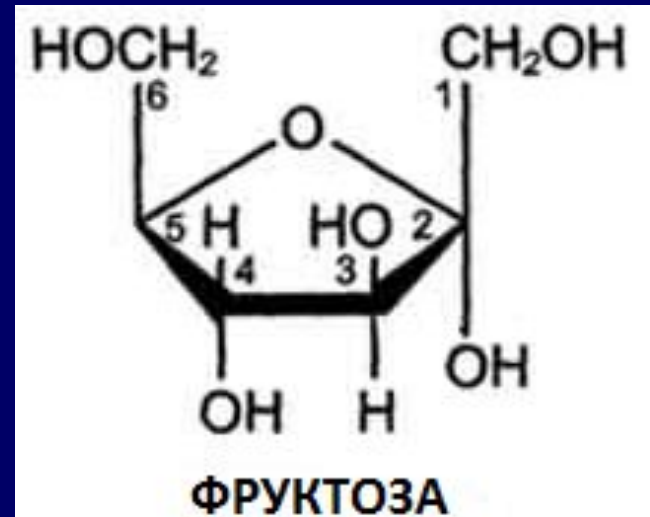
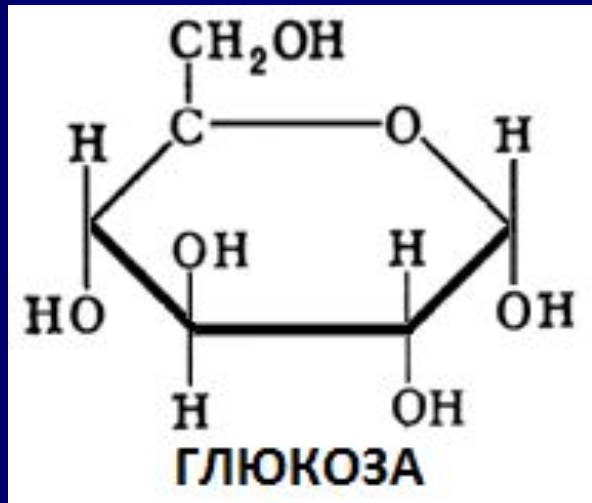
Гликоген

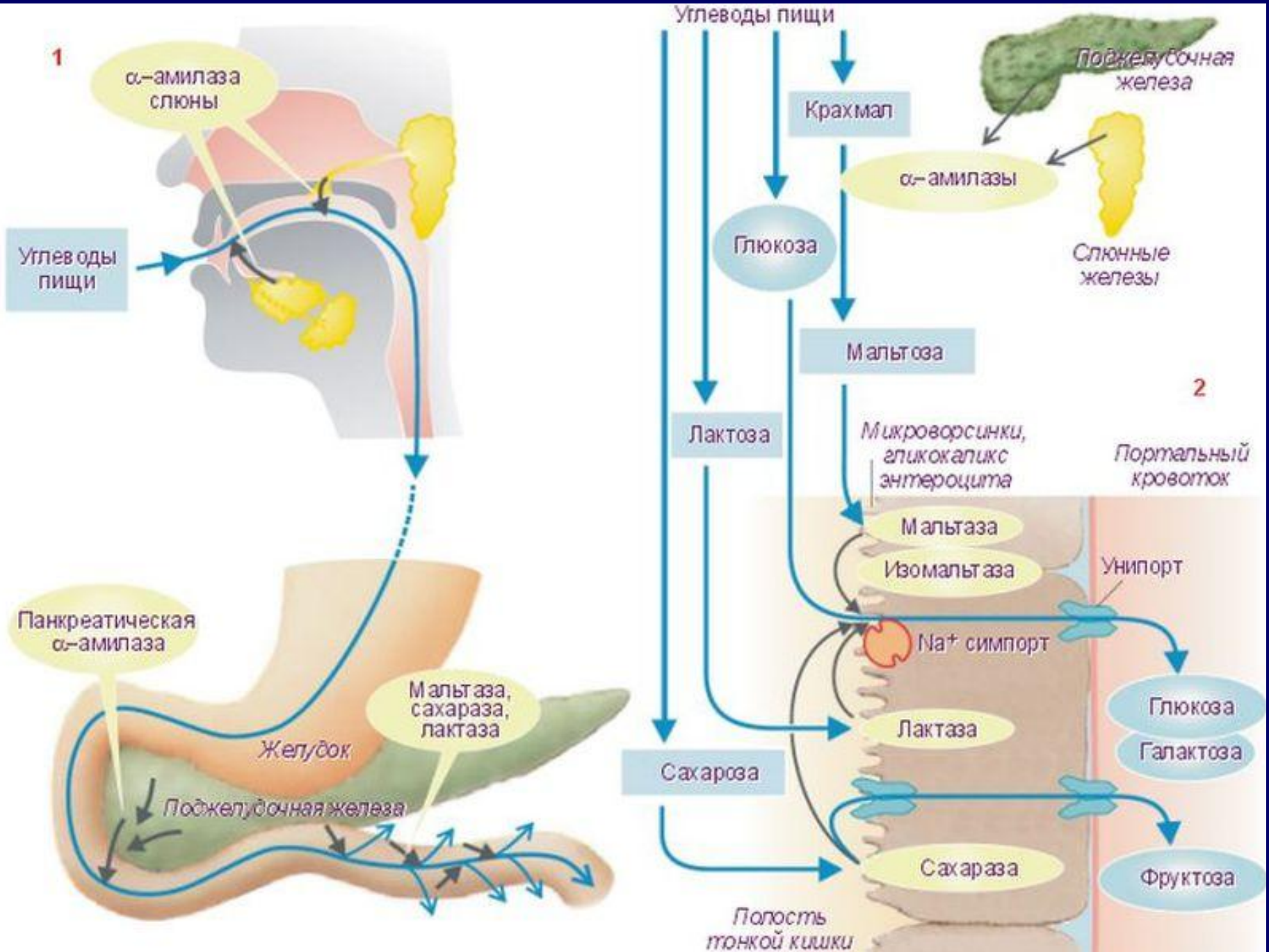


LES DISACCHARIDES



LES MONOSACCHARIDES





1

Углеводы пищи

α -амилаза слюны

Поджелудочная железа

Слюнные железы

α -амилазы

Крахмал

Глюкоза

Мальтоза

2

Портальный кровоток

Микроворсинки, гликокаликс энтероцита

Мальтаза

Изомальтаза

Унипорт

Глюкоза

Галактоза

Лактоза

Сахароза

Сахараза

Фруктоза

Полость тонкой кишки

Желудок

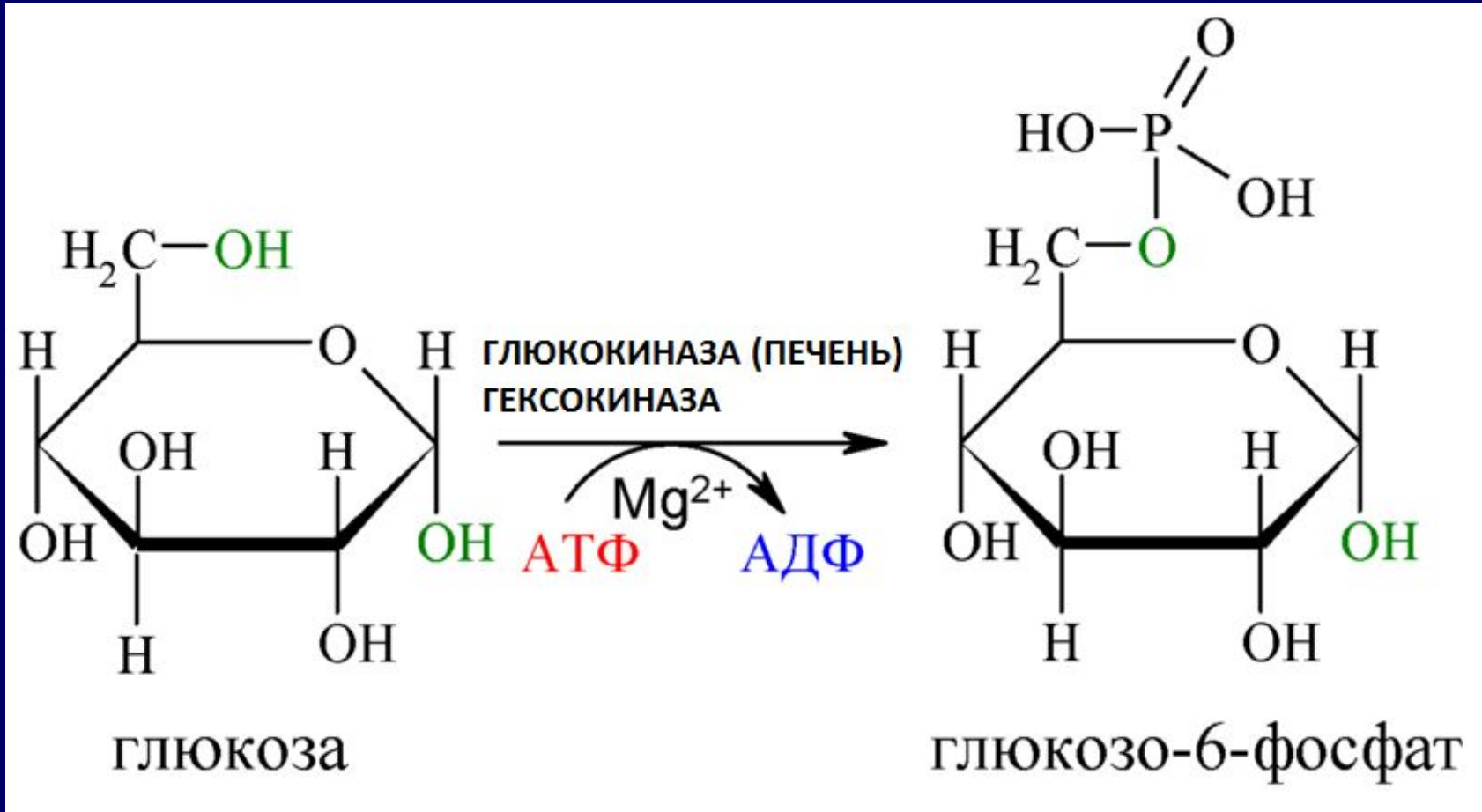
Панкреатическая α -амилаза

Мальтаза, сахараза, лактаза

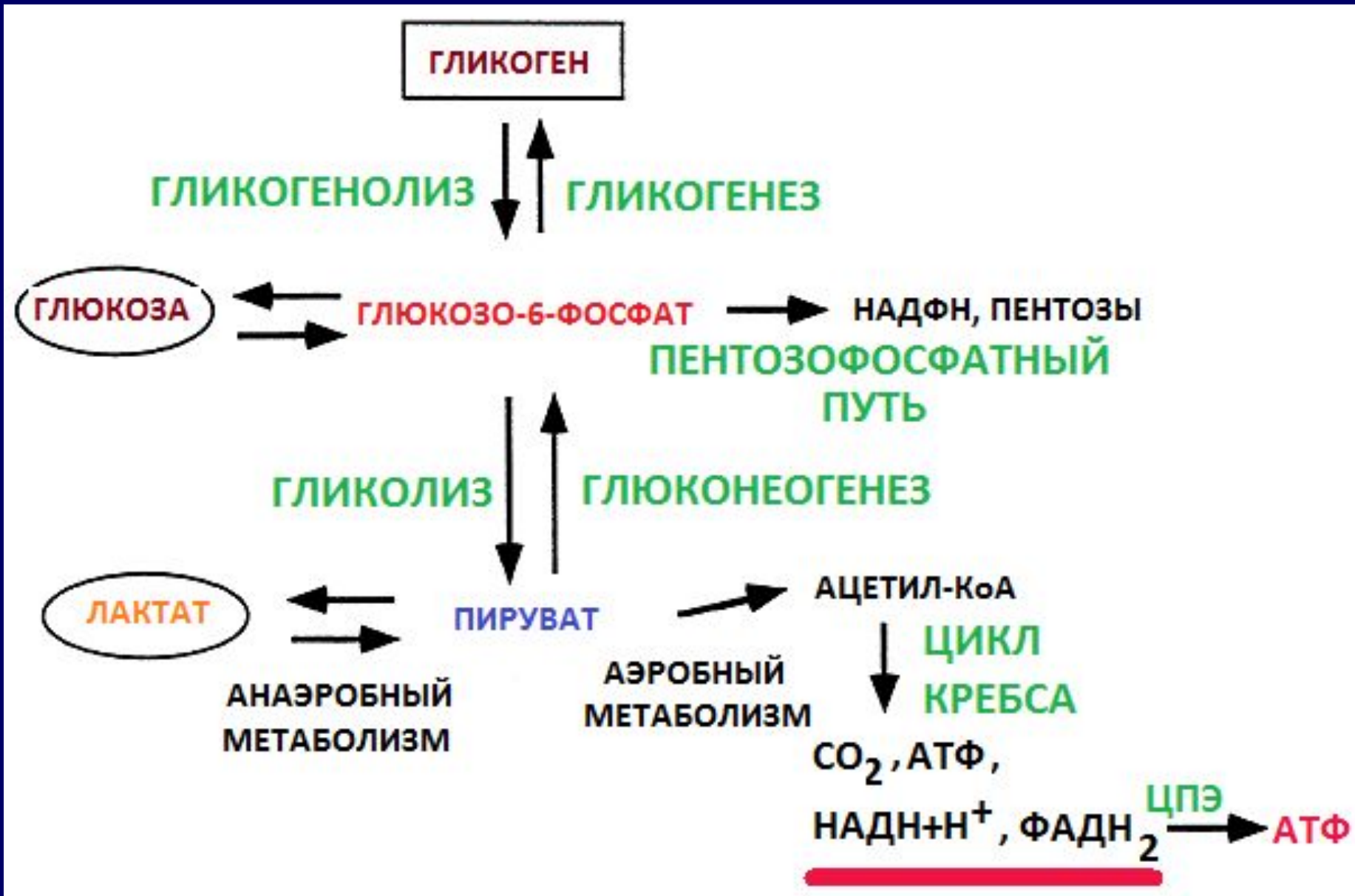
Поджелудочная железа

Na^+ симпорт

LE GLUCOSE-6-PHOSPHATE – LA FORME METABOLIQUEMENT ACTIVE DU GLUCOSE

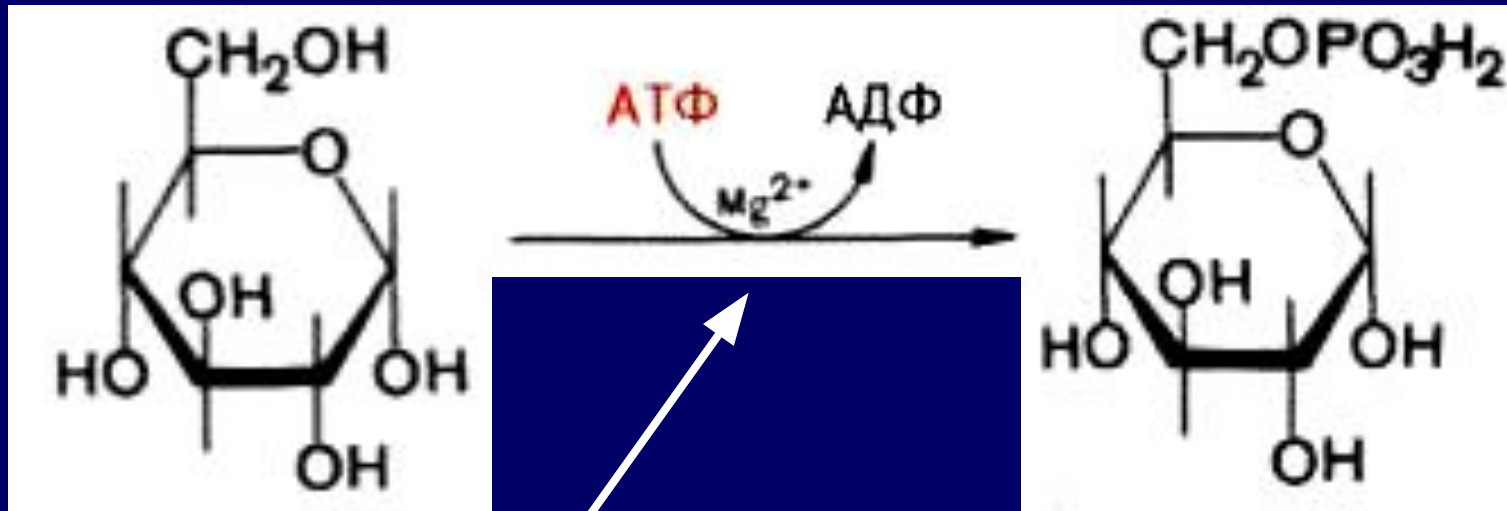


LE METABOLISME DU GLUCOSE



LA GLYCOLYSE

1) LA PHOSPHORYLATION DU GLUCOSE



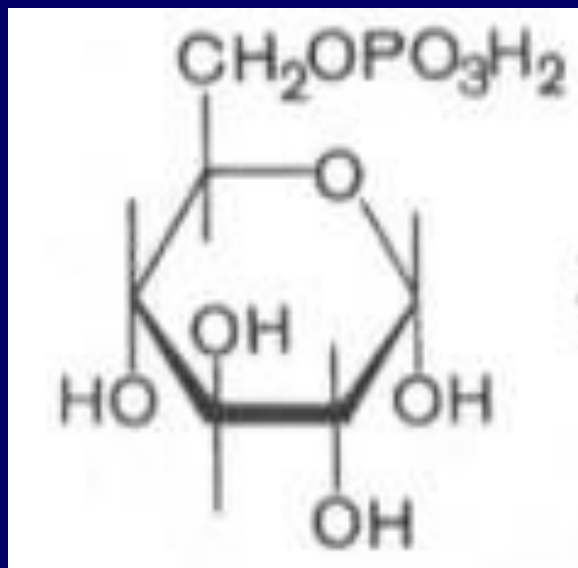
LE GLUCOSE

L'HEXOKINASE

**LE
GLUCOSE-6-PHOSPHA
TE**

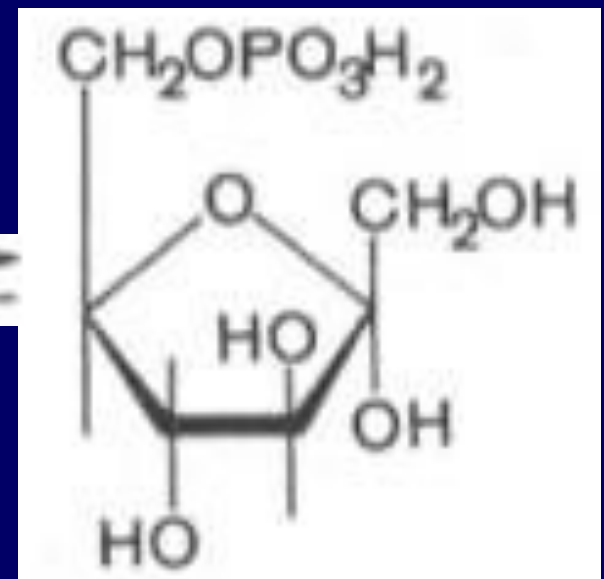
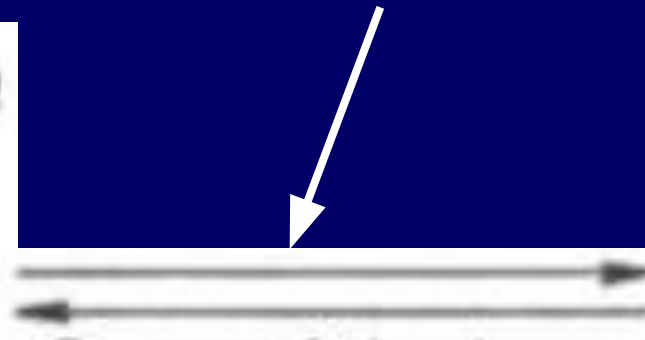
2) L'ISOMERISATION

LA GLUCOSE-6-PHOSPHATE- ISOMERASE



LE

GLUCOSE-6-PHOSPHA
TE

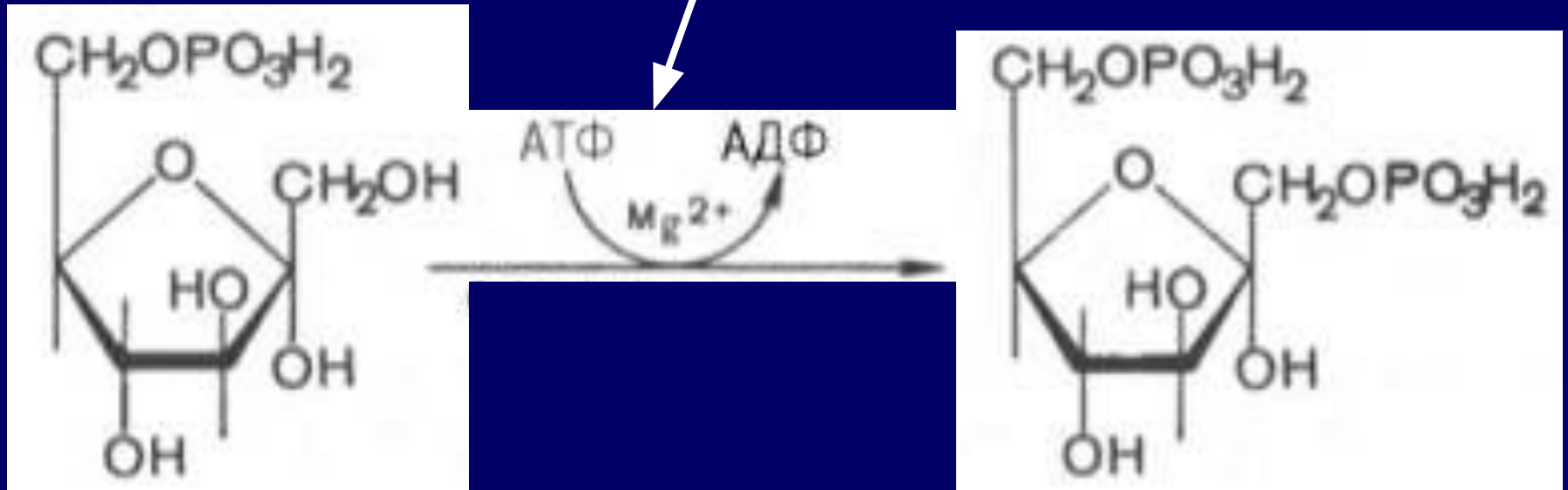


LE

FRUCTOSE-6-PHOSPH
ATE

3) LIMITANTE (LA REACTION DE PHOSPHORYLATION)

LA PHOSPHOFRUCTOKINASE-6



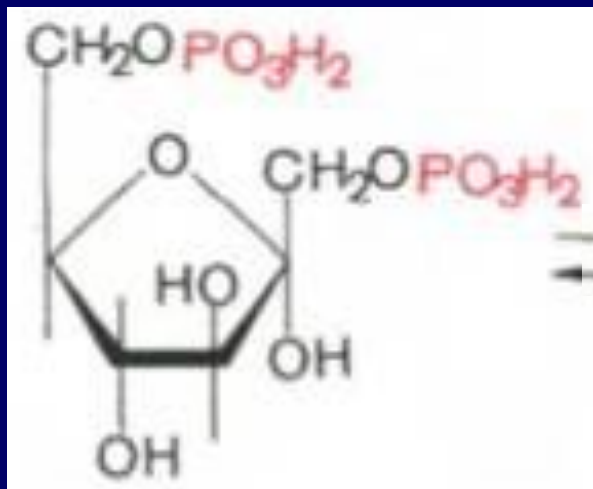
**LE
FRUCTOSE-6-PHOSPH
ATE**

**LE FRUCTOSE-
1,6-BIPHOSPHATE**

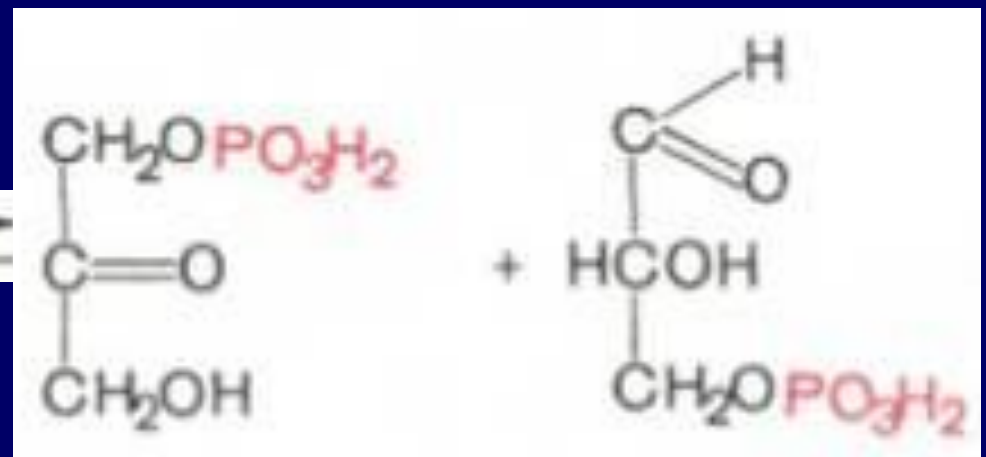
4) LA DESAGREGATION ALDOLIQUE

LE GLYCERALDEHYDE-3- PHOSPHATE

L'ALDOLASE



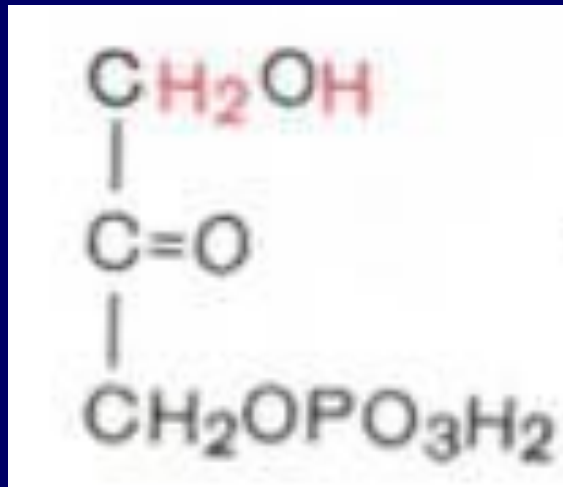
LE FRUCTOSE-
1,6-BIPHOSPHATE



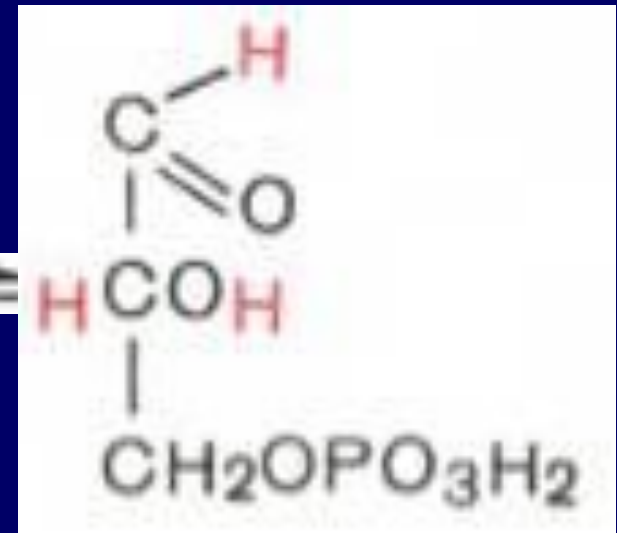
LE
DIOXYACETONE
PHOSPHATE

5) L'ISOMERISATION

LA TRIOSE-PHOSPHATE ISOMERASE

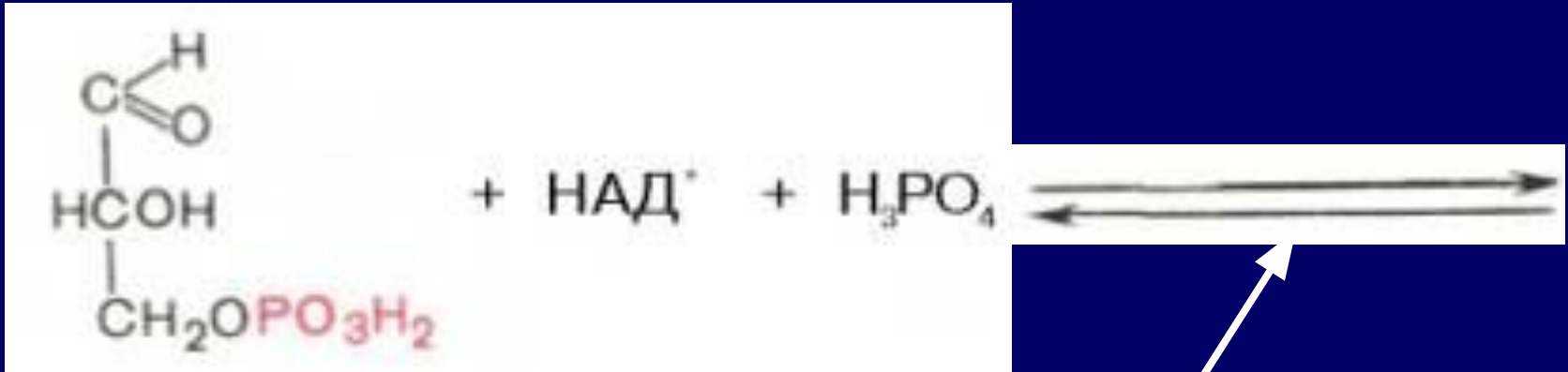


**LE
DIOXYACETONE
PHOSPHATE**



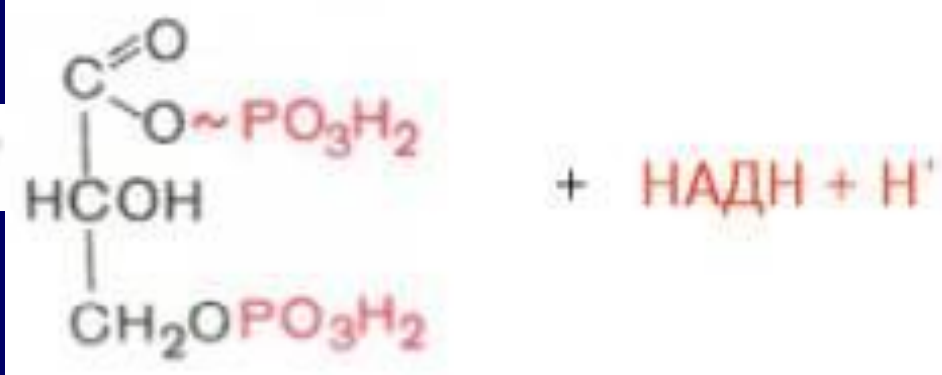
**LE
GLYCERALDE
HYDE-3-
PHOSPHATE**

6) LA REACTION D'OXYDATION



**LE
GLYCERALDE
HYDE-3-
PHOSPHATE**

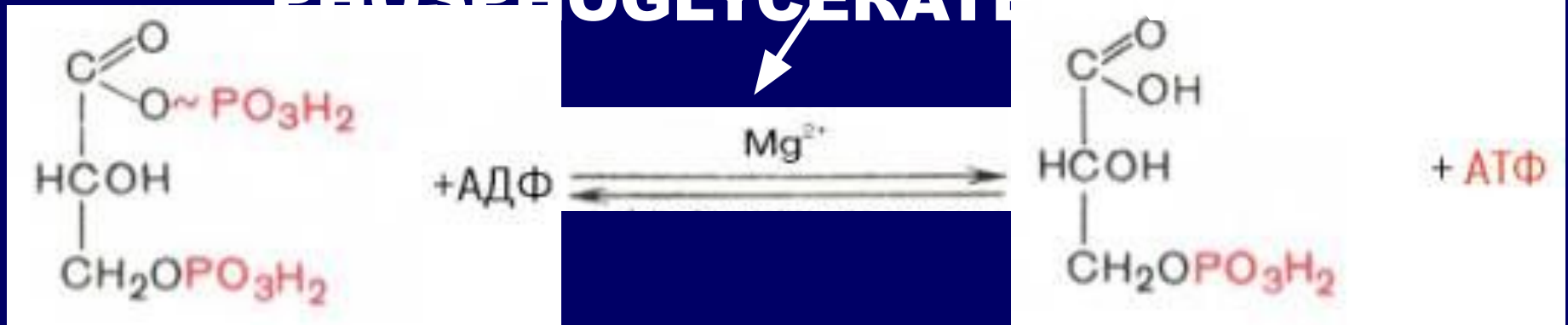
**LA GLYCERALDEHYDE
PHOSPHATE
DESHYDROGENASE**



**LE
1,3-BISPHOSPHOGLYCER
ATE**

7) LA PHOSPHORYLATION AU NIVEAU DU SUBSTRAT

LA
PHOSPHOGLYCERATE KINASE

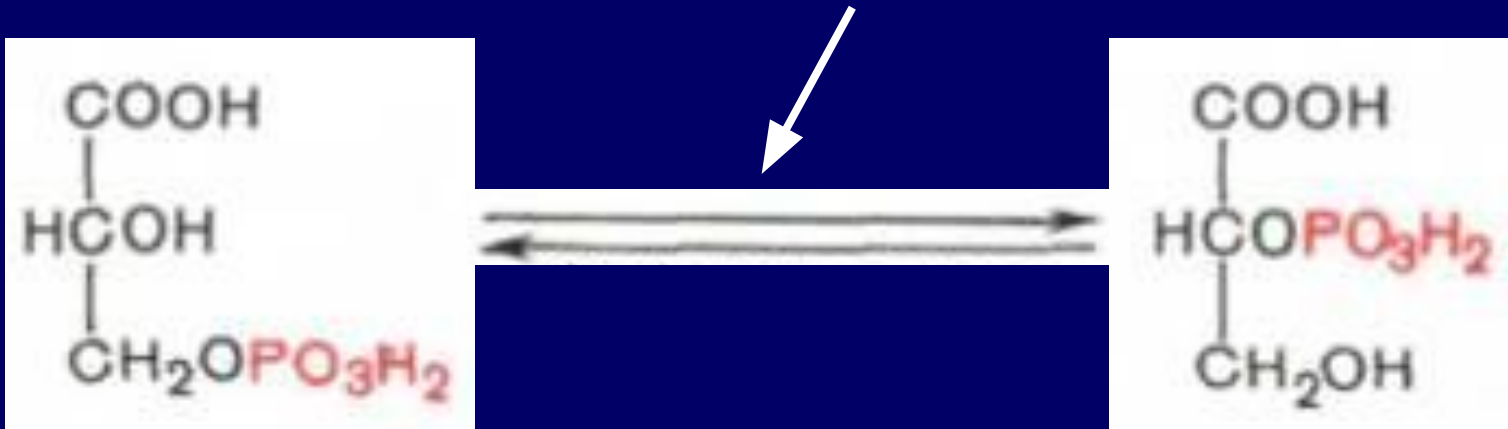


LE
1,3-BISPHOSPH
OGLYCERATE

LE
3-PHOSPHOGLY
CERATE

8) LE TRANSFERT INTRAMOLECULAIRE DU GROUPE PHOSPHATE

LA PHOSPHOGLYCERATE MUTASE

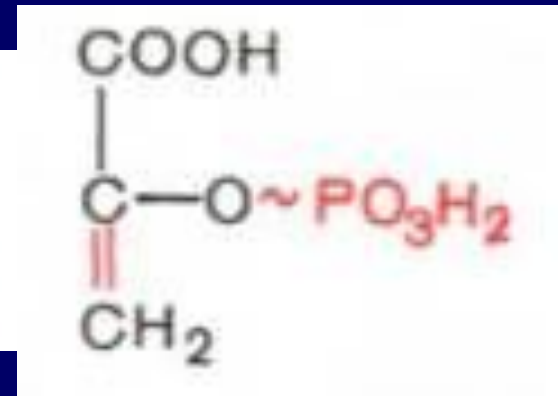
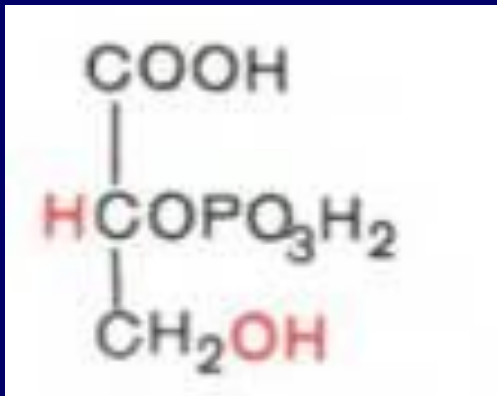


LE
**3-PHOSPHOGL
YCERATE**

LE
**2-PHOSPHOGL
YCERATE**

9) LA REACTION DE DESHYDRATATION

L'ENOLASE

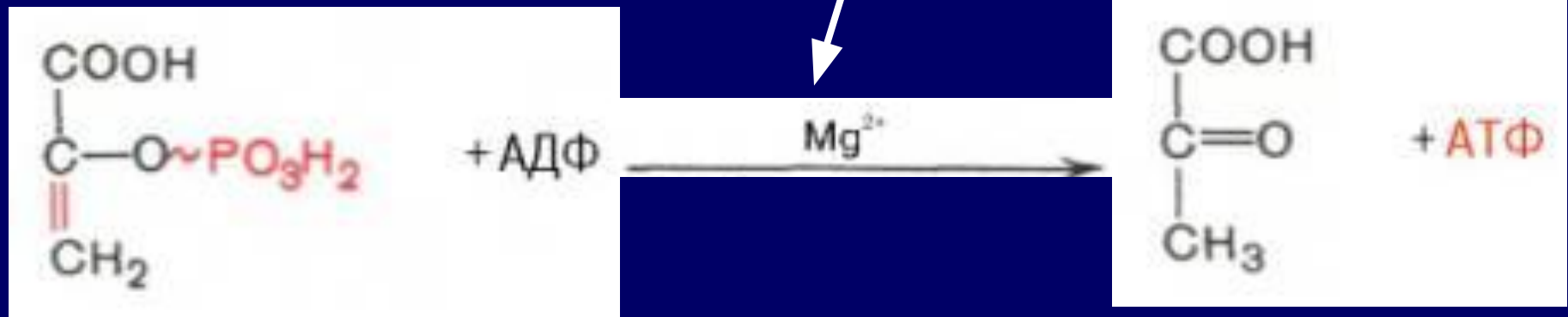


LE
2-PHOSPHOGL
YCERATE

LE
PHOSPHOENOL
PYRUVATE

10) LA PHOSPHORYLATION AU NIVEAU DU SUBSTRAT

LA PYRUVATEKINASE

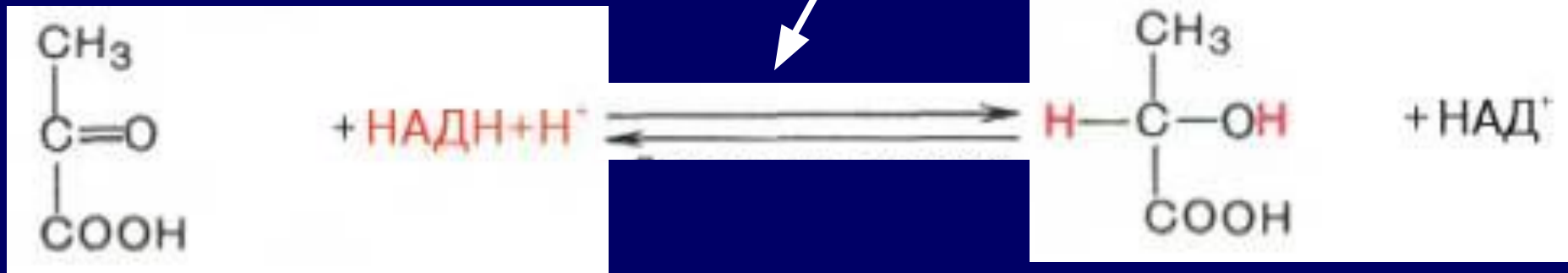


**LE
PHOSPHOENOL
PYRUVATE**

**L'ACIDE
PYRUVIQUE**

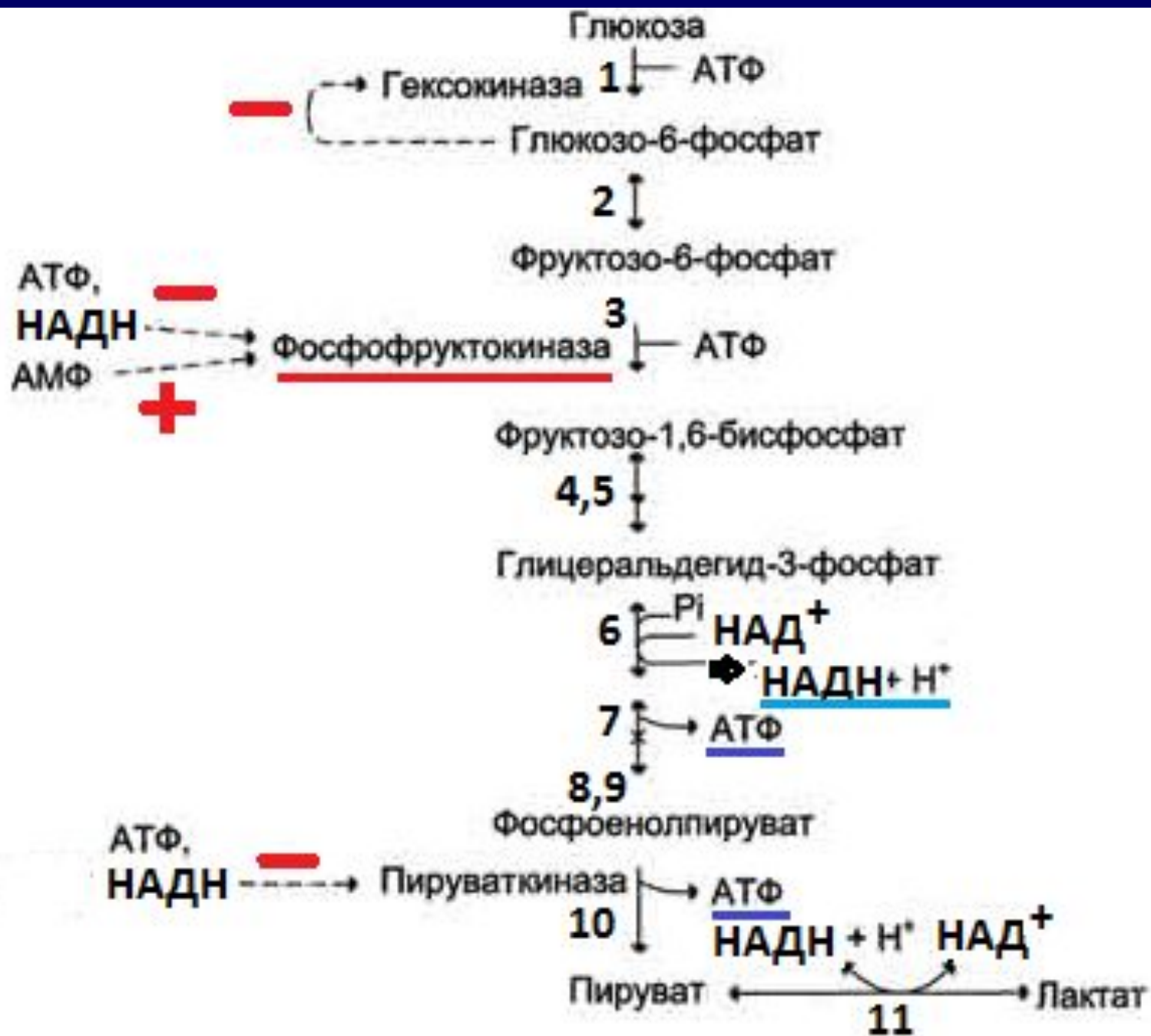
11) LA REACTION SE DEROULE SI LA GLYCOLYSE EST ANAEROBIE

LA LACTATE DESHYDROGENASE

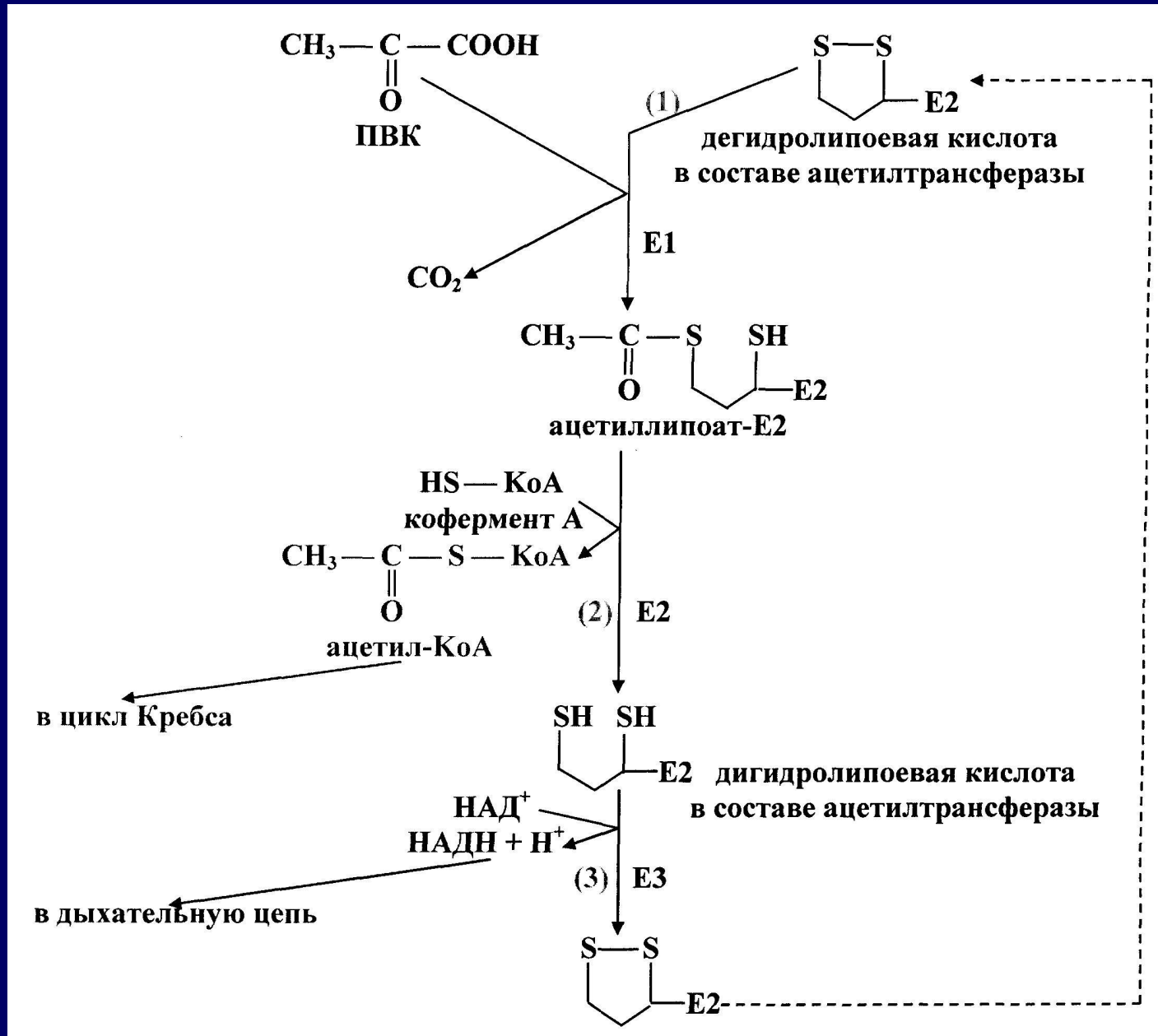


**L'ACIDE
PYRUVIQUE**

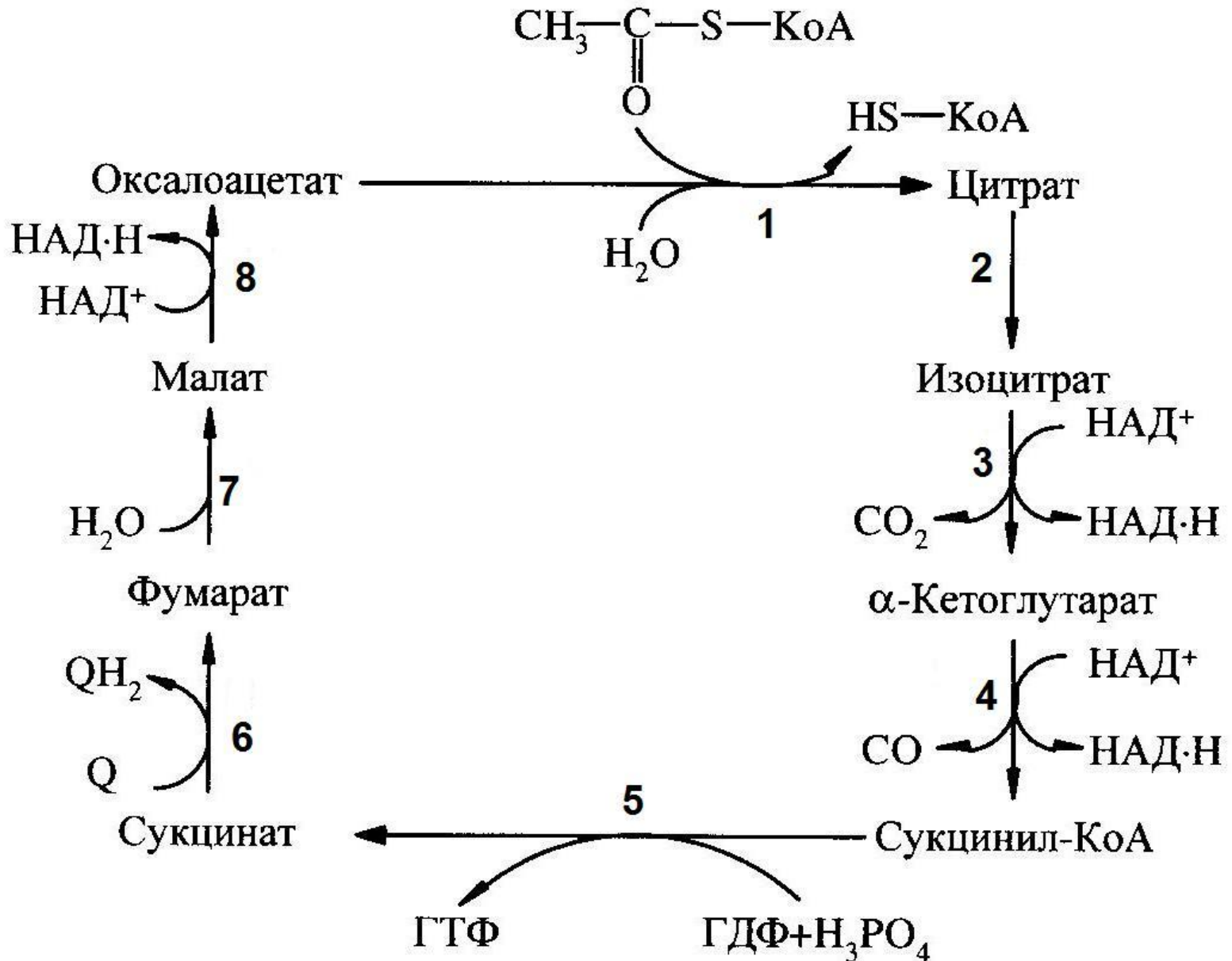
**LE LACTATE
(ACIDE
LACTIQUE)**



LA DECARBOXYLATION OXYDATIVE DE L'ACIDE PYRUVIQUE



LE SCHEMA GENERAL DU CYCLE DE KREBS



LA SORTIE DE L'ATP LORS DE LA GLYCOLYSE AEROBIE:

- LA PHOSPHORYLATION AU NIVEAU DU SUBSTRAT (LES REACTIONS 7, 10 DE GLYCOLYSE; 5 – CYCLES) = 3 ATP

- LA REACTION DE DESHYDRATATION (6 – LA GLYCOLYSE; 3 – LA DECARBOXYLATION OXYDATIVE DE L'ACIDE PYRUVIQUE; 3, 4, 8 – CYCLES) = 3 ATP x 5 NADH = 15 ATP

- LA REACTION DE DESHYDRATATION AVEC FAD (6 – CYCLES) = 2 ATP x FADH₂ = 2 ATP

- LES REACTIONS 4, 5 DE GLYCOLYSE:

1C₆H₁₂O₆ → **2**GLYCERALDEHYDE-3-PHOSPHATE
2 x (3 ATP + 15 ATP + 2 ATP) = 40 ATP

- DANS LES REACTIONS 1, 3 DE GLYCOLYSE 2 ATP SONT DEPENSEES, ALORS

40 ATP – 2 ATP = **38 ATP**

OU:

- LA PHOSPHORYLATION AU NIVEAU DU SUBSTRAT (LES REACTIONS 7, 10 DE GLYCOLYSE; = 2 ATP;
- LA REACTION DE DESHYDRATATION (6 – LA GLYCOLYSE) = 3 ATP;
- LA DECARBOXYLATION OXYDATIVE DE L'ACIDE PYRUVIQUE = 3 ATP;
- LE CYCLE DE KREBS = 12 ATP;
- LES REACTIONS 4, 5 DE GLYCOLYSE:
 $1 \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2 \text{GLYCERALDEHYDE-3-PHOSPHATE}$
 $2 \times (2 \text{ ATP} + 3 \text{ ATP} + 3 \text{ ATP} + 12 \text{ ATP}) = \underline{40 \text{ ATP}}$;
- DANS LES REACTIONS 1, 3 DE GLYCOLYSE
2 ATP SONT DEPENSEES, ALORS
40 ATP – 2 ATP = **38 ATP**

LA SORTIE DE L'ATP LORS DE LA GLYCOLYSE ANAEROBIE:

- LES REACTIONS 4, 5 DE GLYCOLYSE:



GLYCERALDEHYDE-3-PHOSPHATE
(COEFFICIENT «2»)

- LA PHOSPHORYLATION AU NIVEAU DU
SUBSTRAT

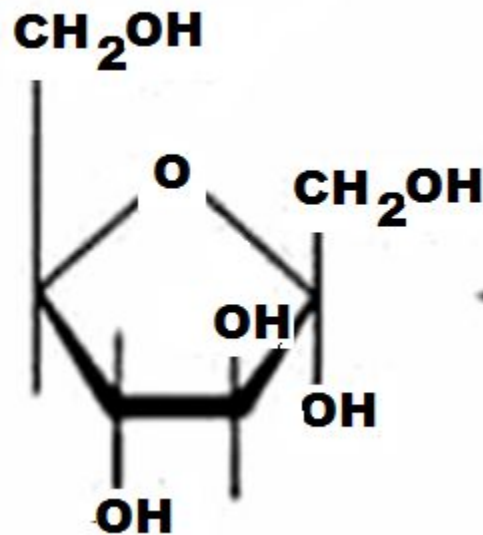
(LES REACTIONS 7, 10 DE GLYCOLYSE) =
= $2 \text{ ATP} \times 2 = \underline{4 \text{ ATP}}$

- DANS LES REACTIONS 1, 3 DE GLYCOLYSE
2 ATP SONT DEPENSEES, ALORS

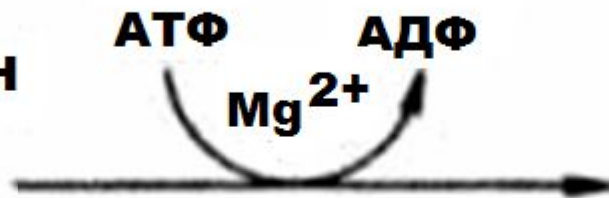
$$\underline{4 \text{ ATP}} - 2 \text{ ATP} = 2 \text{ ATP}$$

LA PARTICIPATION DU FRUCTOSE A LA GLYCOLYSE

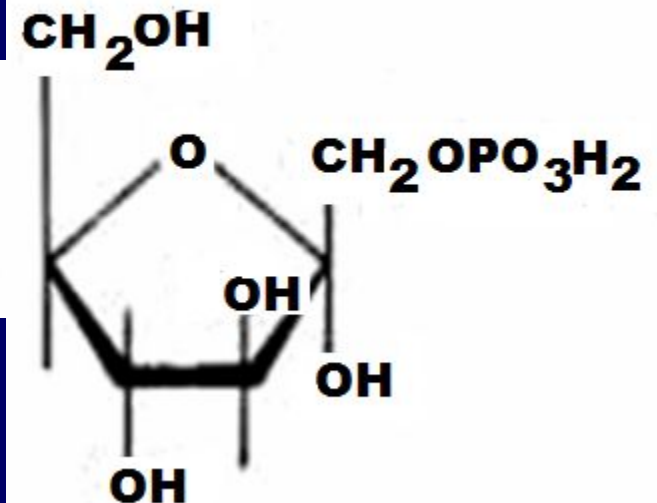
LE FOIE



LE
FRUCTOSE



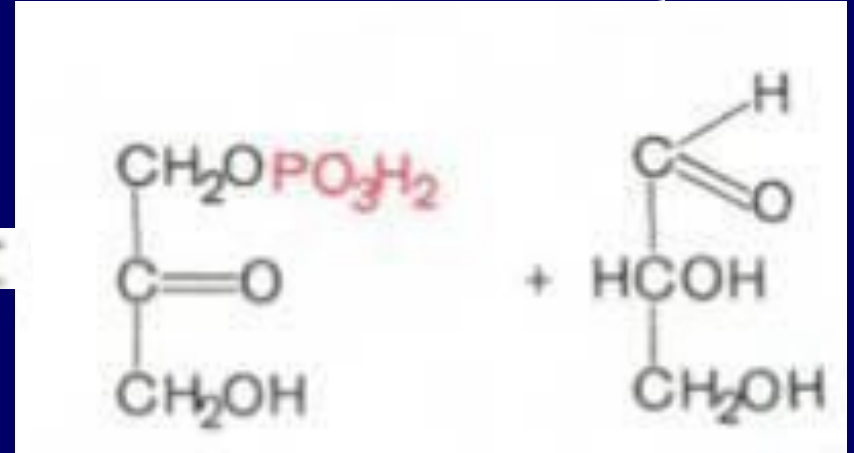
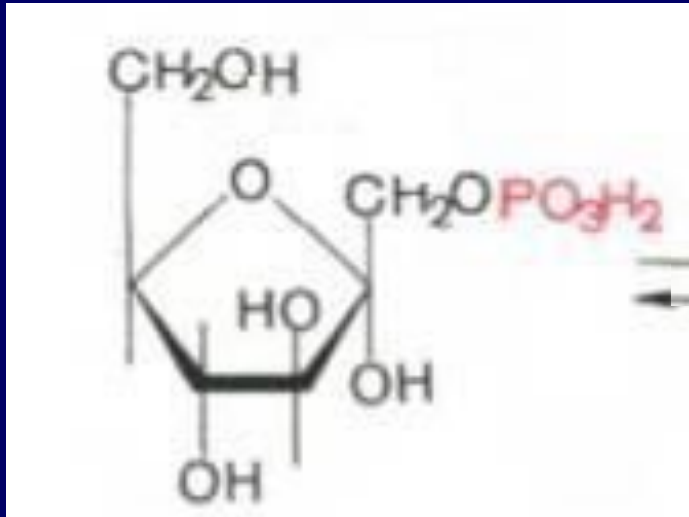
LA
FRUCTOKINASE



LE
FRUCTOSE-1-PHOSPHA
TE

L'ALDOLASE

**LE
GLYCERALDEHYDE**



**LE DIOXYACETONE-
PHOSPHATE**

**LE
FRUCTOSE-1-PHOSPHA
PARTICIPE A LA 5EME REACTION DE GLYCOLYSE**

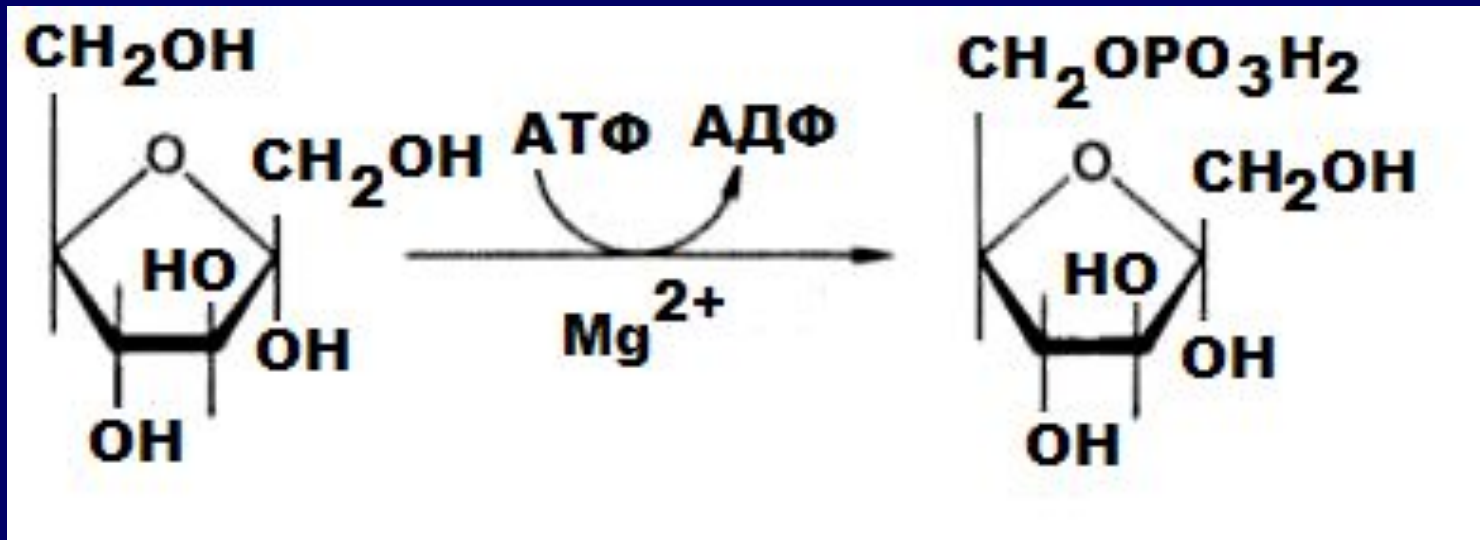
**LE
GLYCERALDEHYDE**

**LE GLYCERALDEHYDE-
3-PHOSPHATE**

**PARTICIPE A LA 6EME REACTION DE
GLYCOLYSE**

LE TISSU MUSCULAIRE, LES REINS, LE TISSU ADIPEUX

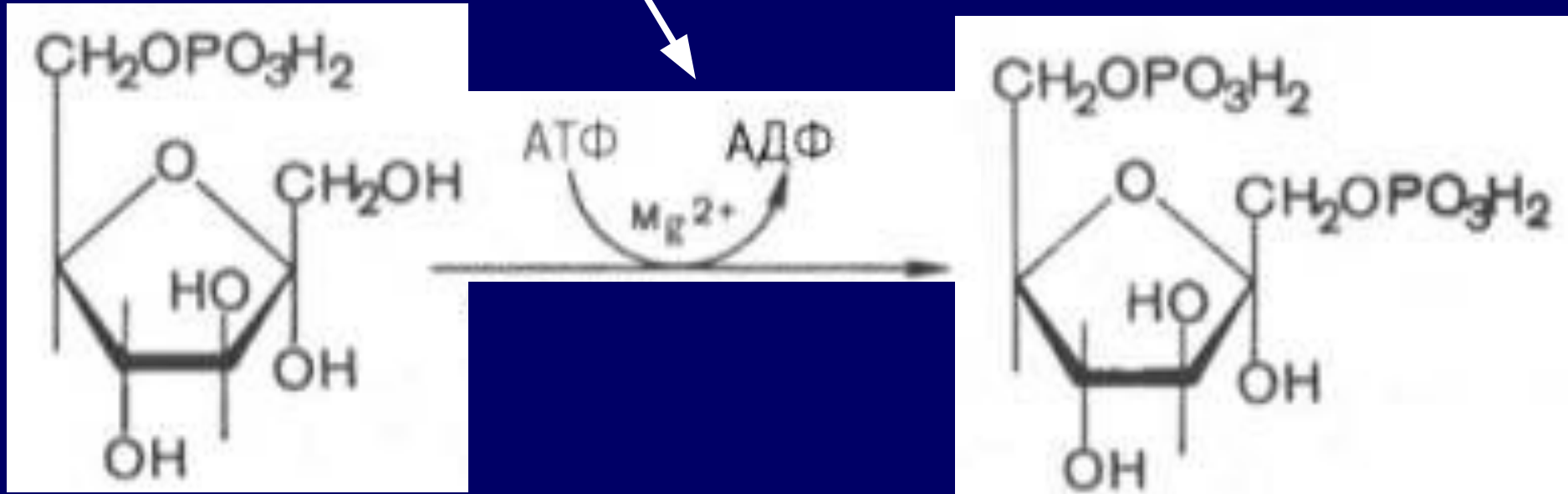
L'HEXOKINASE



LE FRUCTOSE

LE
FRUCTOSE-6-PHOSPHA
TE

LE 6-PHOSPHOFRUCTOKINASE

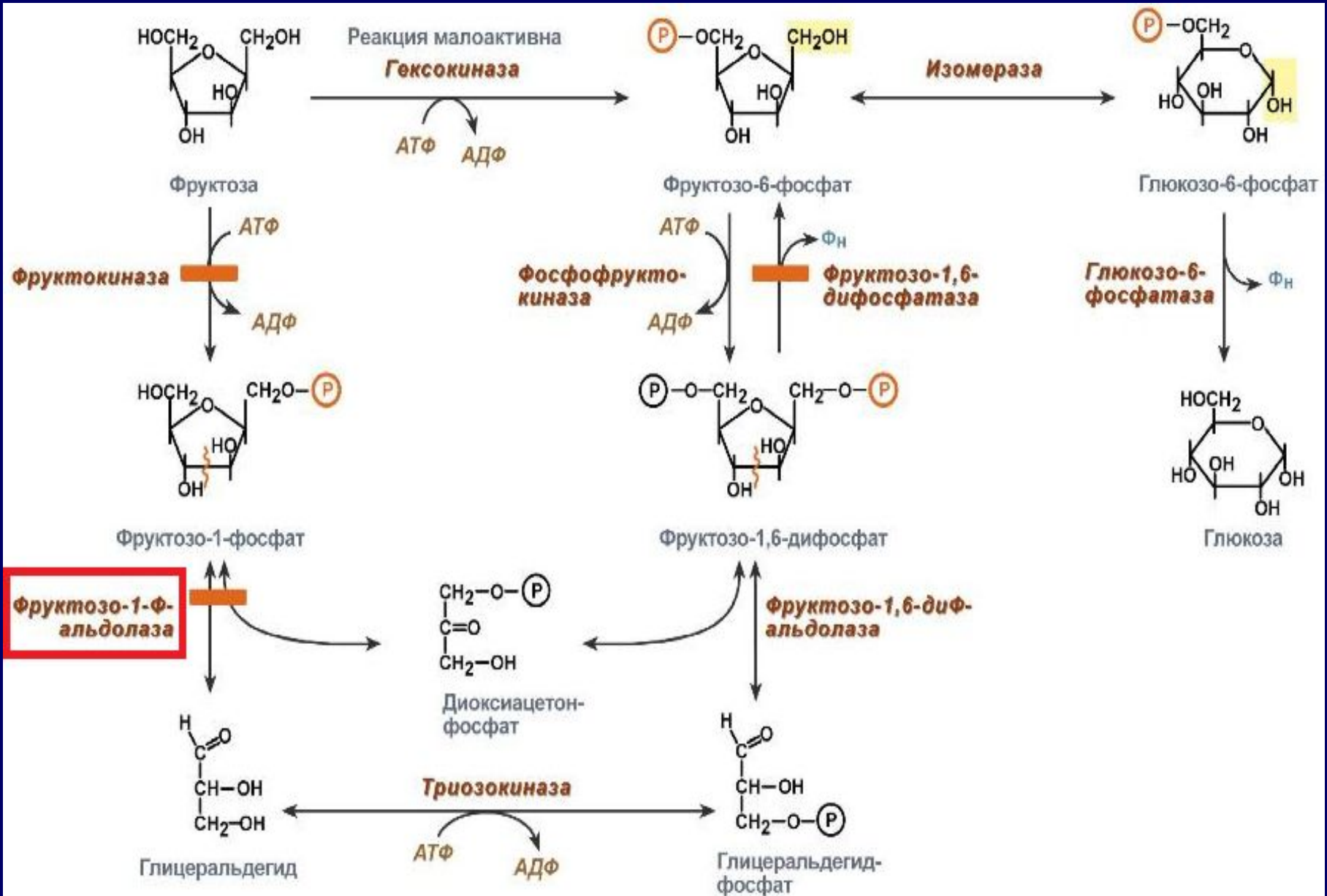


**LE
FRUCTOSE-6-PHOS
PHATE**

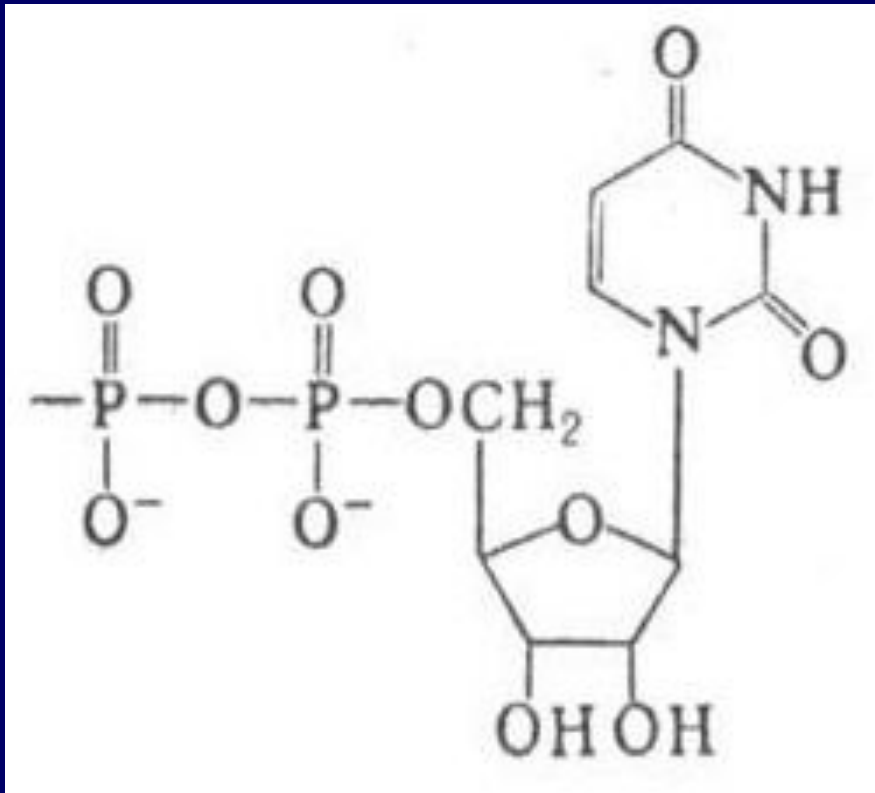
**LE
FRUCTOSE-1,6-BIP
HOSPHATE**

**PARTICIPE A LA 4EME REACTION DE
GLYCOLYSE**

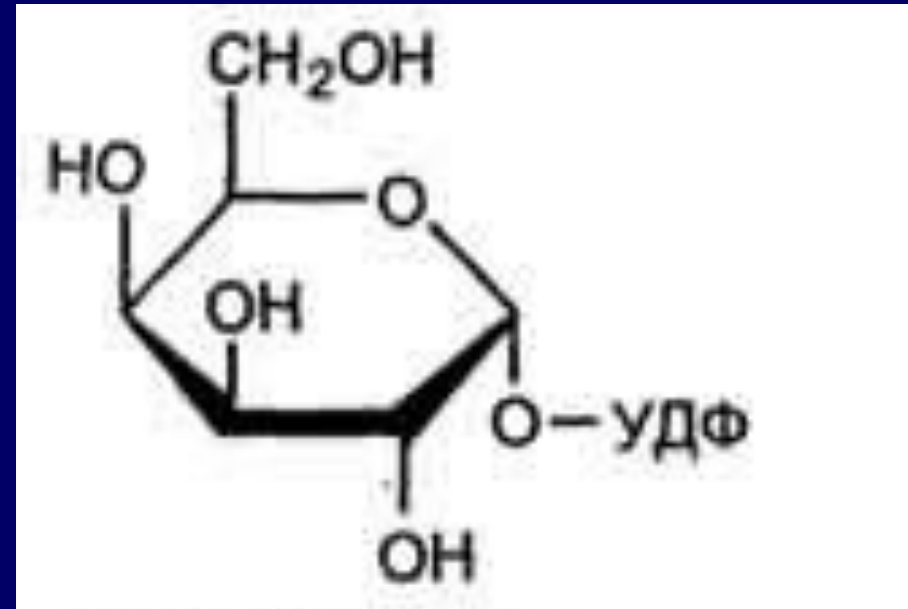
LE TROUBLE DU METABOLISME DU FRUCTOSE



LA PARTICIPATION DU GALACTOSE A LA GLYCOLYSE

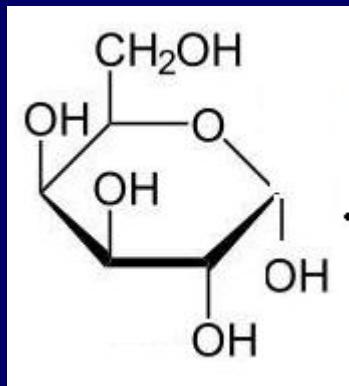


**L'URIDINE
DIPHOSPHATE**

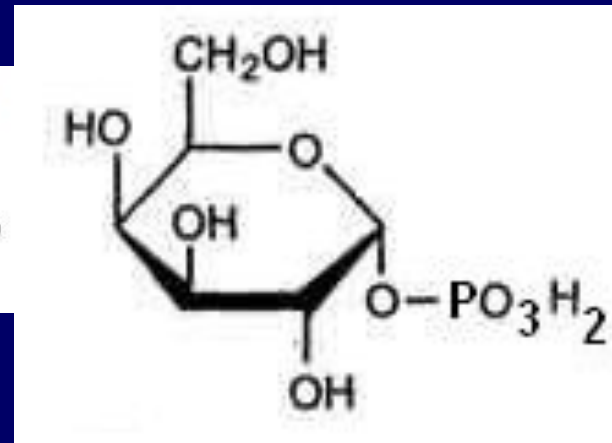


L'UDP-GALACTOSE

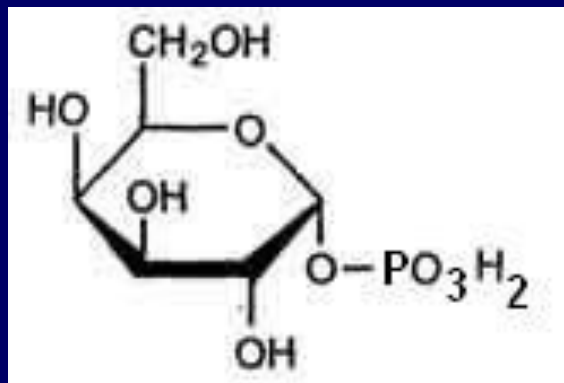
LA GALACTOKINASE



**LE
GALACTOSE**

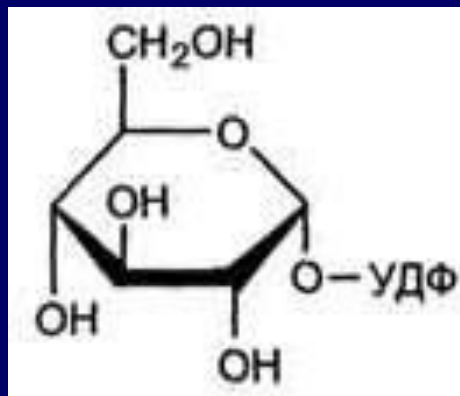


**LE
GALACTOSE-1-PHOSPHA
TE**



**LE
GALACTOSE-1-
PHOSPHATE**

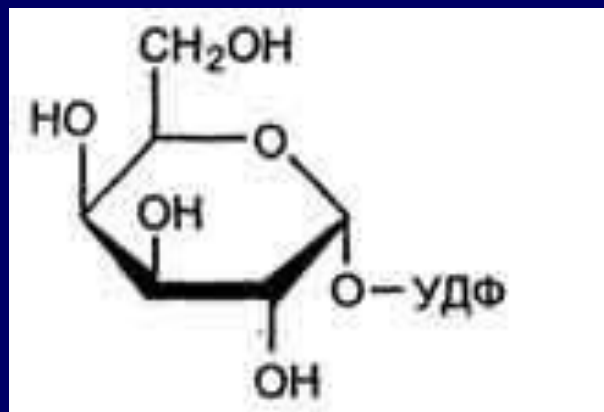
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**L'UDP-GLUCO
SE**

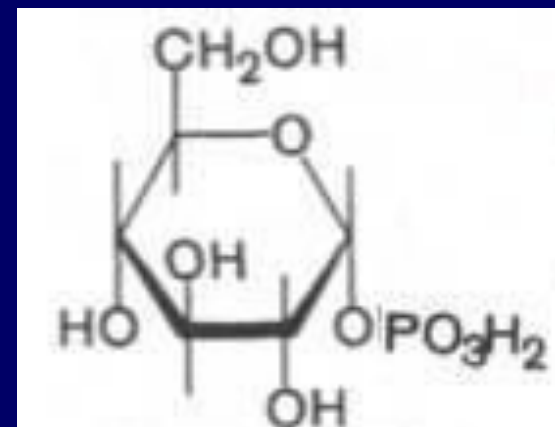


**L'HEXOSE-1-
PHOSPHATE-URYD
YL-TRANSFERASE**



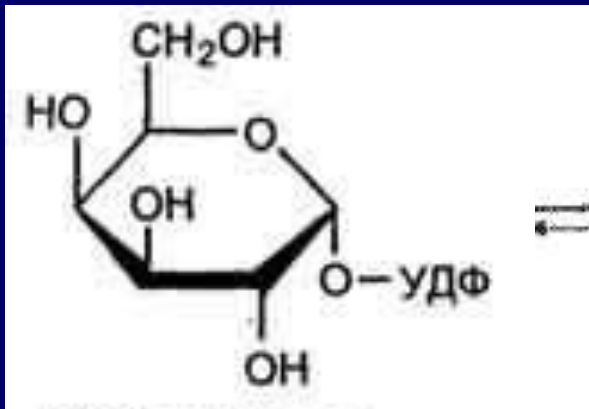
**L'UDP-GALAC
TOSE**

+

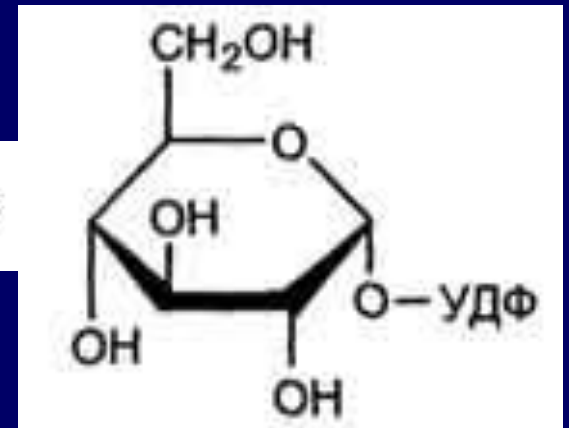


**LE GLUCOSE-1-
PHOSPHATE**

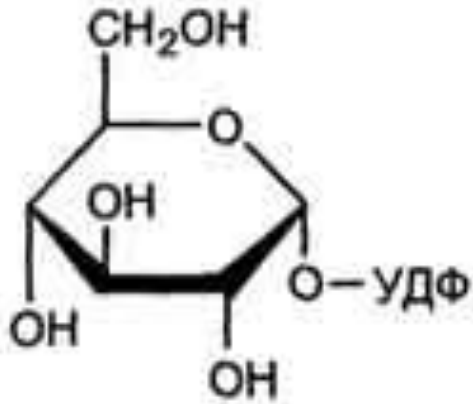
L'UDP-GLUCOSE-4-EPIMERASE



**L'UDP
-GALACTOSE**

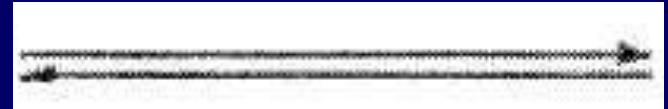


**L'UDP
-GLUCOSE**

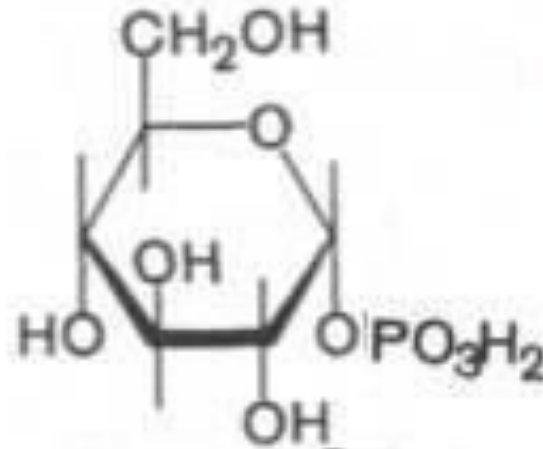
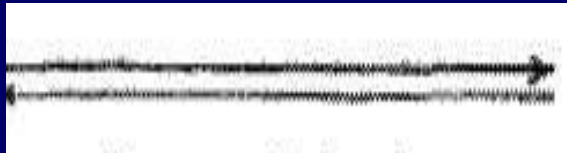


**L'UDP
-GLUCOSE**

+ PP_i

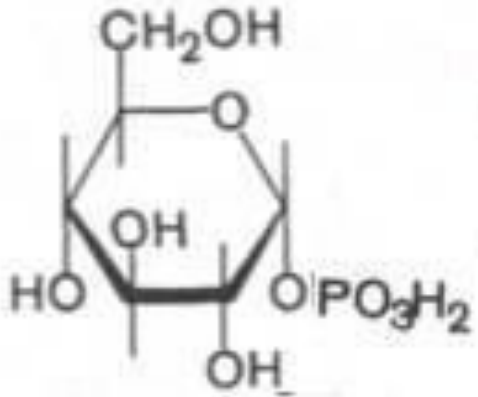


**L'UDP -GLUCOSE-
PYROPHOSPHORYLASE**

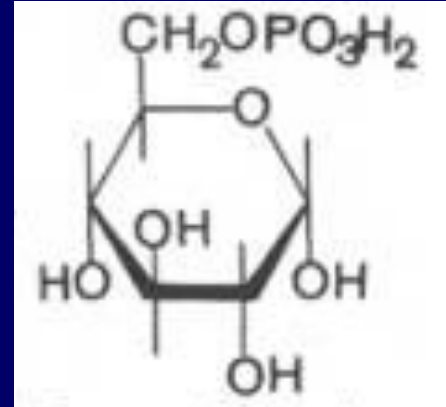


**LE GLUCOSE-1-
PHOSPHATE**

+ UTP



LA
PHOSPHOGLUCOMUTASE



**LE GLUCOSE-1-
PHOSPHATE**

**LE GLUCOSE-6-
PHOSPHATE**

**PARTICIPE A LA 2-EME REACTION DE
GLYCOLYSE**

LA GALACTOSEMIE



LA GALACTOSEMIE DU TYPE I (L'INSUFFISANCE DE LA GALACTOSE-1-PHOSPHATE-URIDYL-TRANSFERASE)



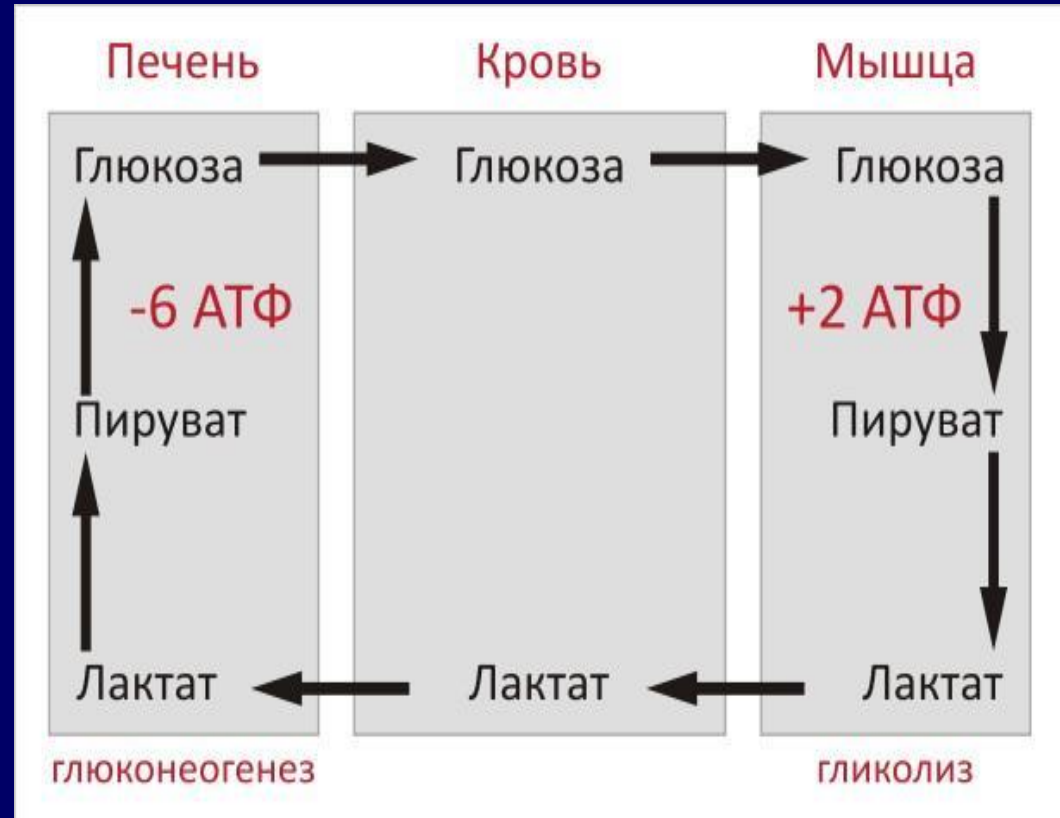
LA NAVETTE DU GLYCEROL PHOSPHATE



LA NAVETTE MALATE-ASPARTATE

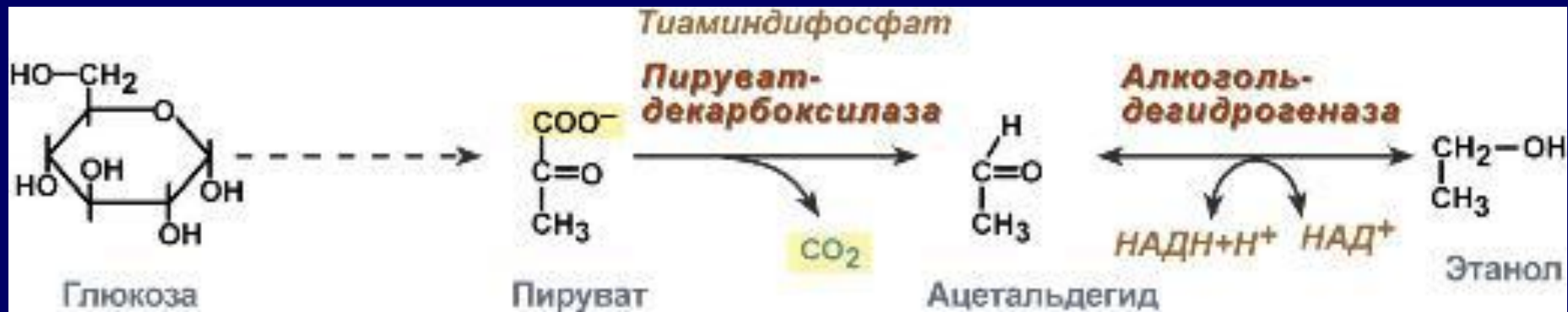


LE CYCLE DE CORI

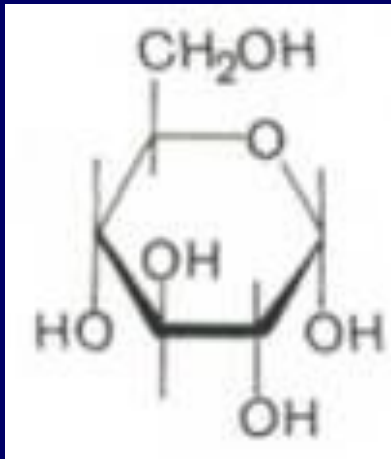


THERESA CORI

LA FERMENTATION ALCOOLIQUE



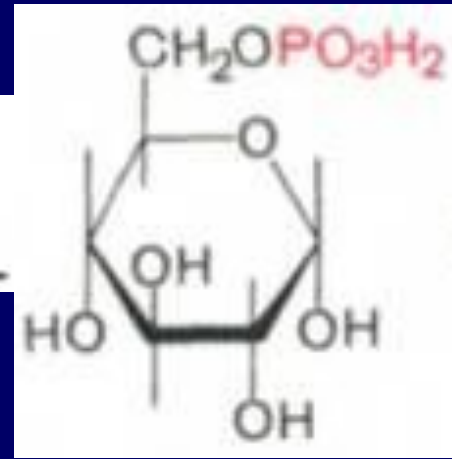
LA SYNTHÈSE DU GLYCOGÈNE (LA GLYCOGÈNESE)



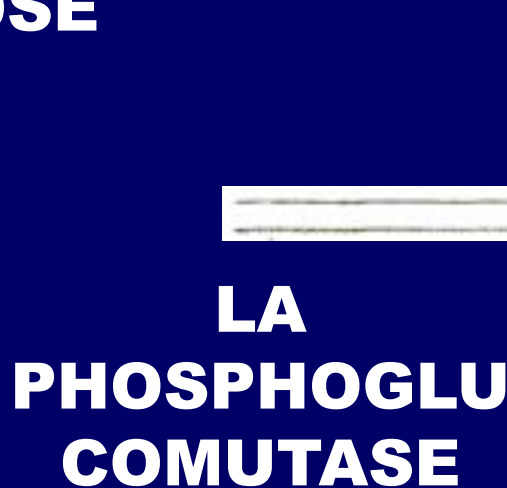
**LE
GLUCOSE**



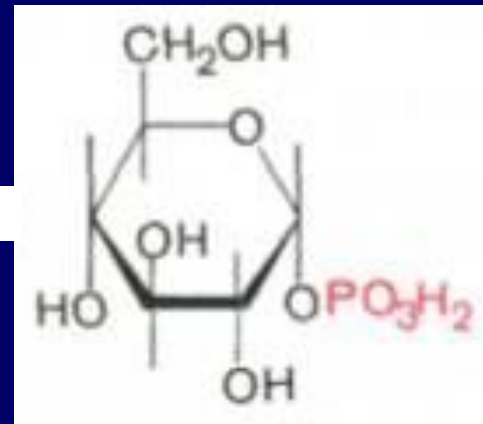
**L'HEXO
KINASE**



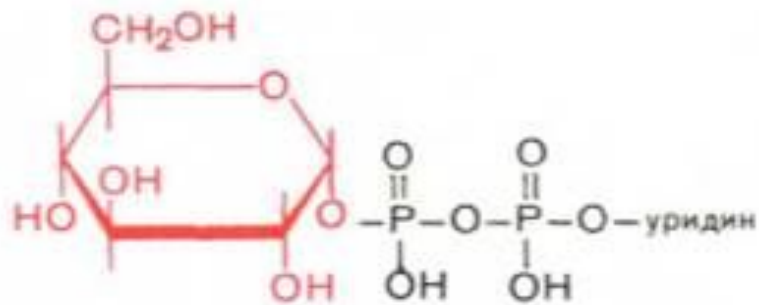
LE GLUCOSE-6-PHOSPHATE



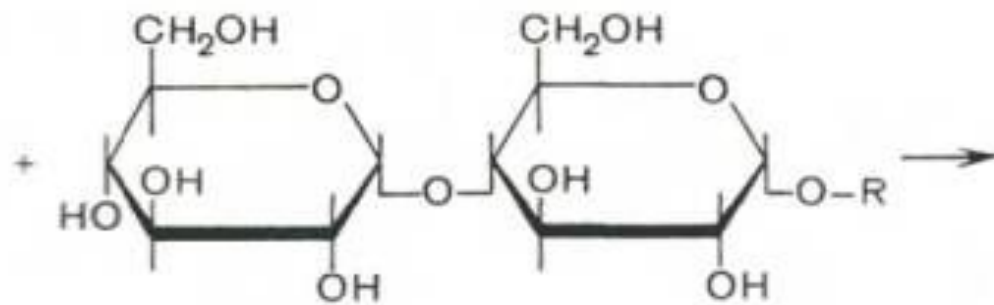
**LA
PHOSPHOGLU
COMUTASE**



LE GLUCOSE-6-PHOSPHATE



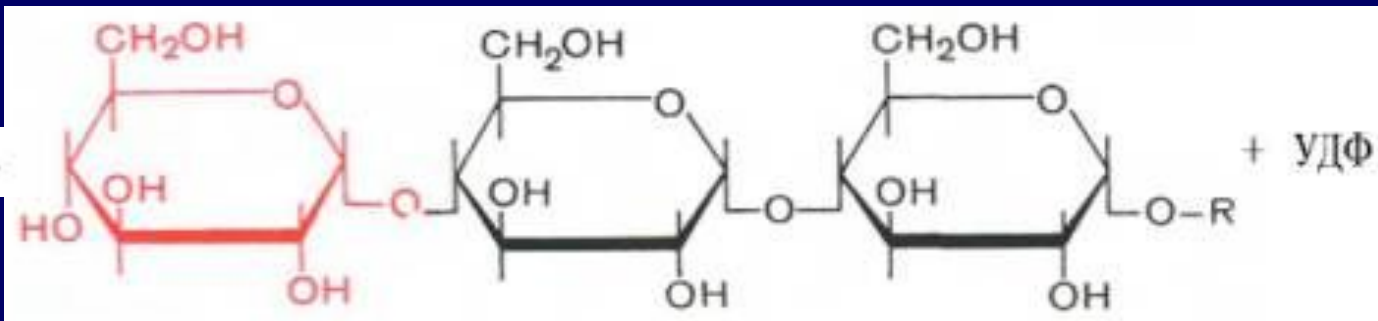
L'UDP-GLUCOSE



LE GLYCOGENE (n de RESIDUS)



**LA
GLYCOGENE
SYNTHASE**



**LE GLYCOGENE (n+1
RESIDU)**

LA DECOMPOSITION DU GLYCOGENE (LA GLYCOGENOLYSE)

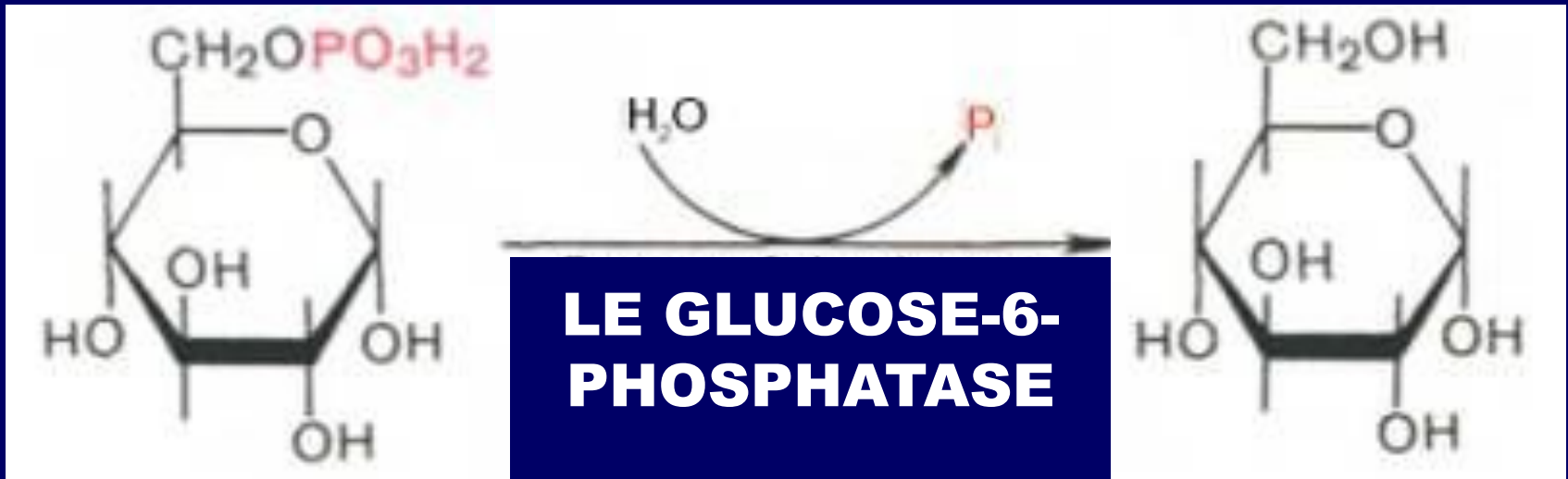


LE

GLUCOSE-1-PHOSPHA
TE

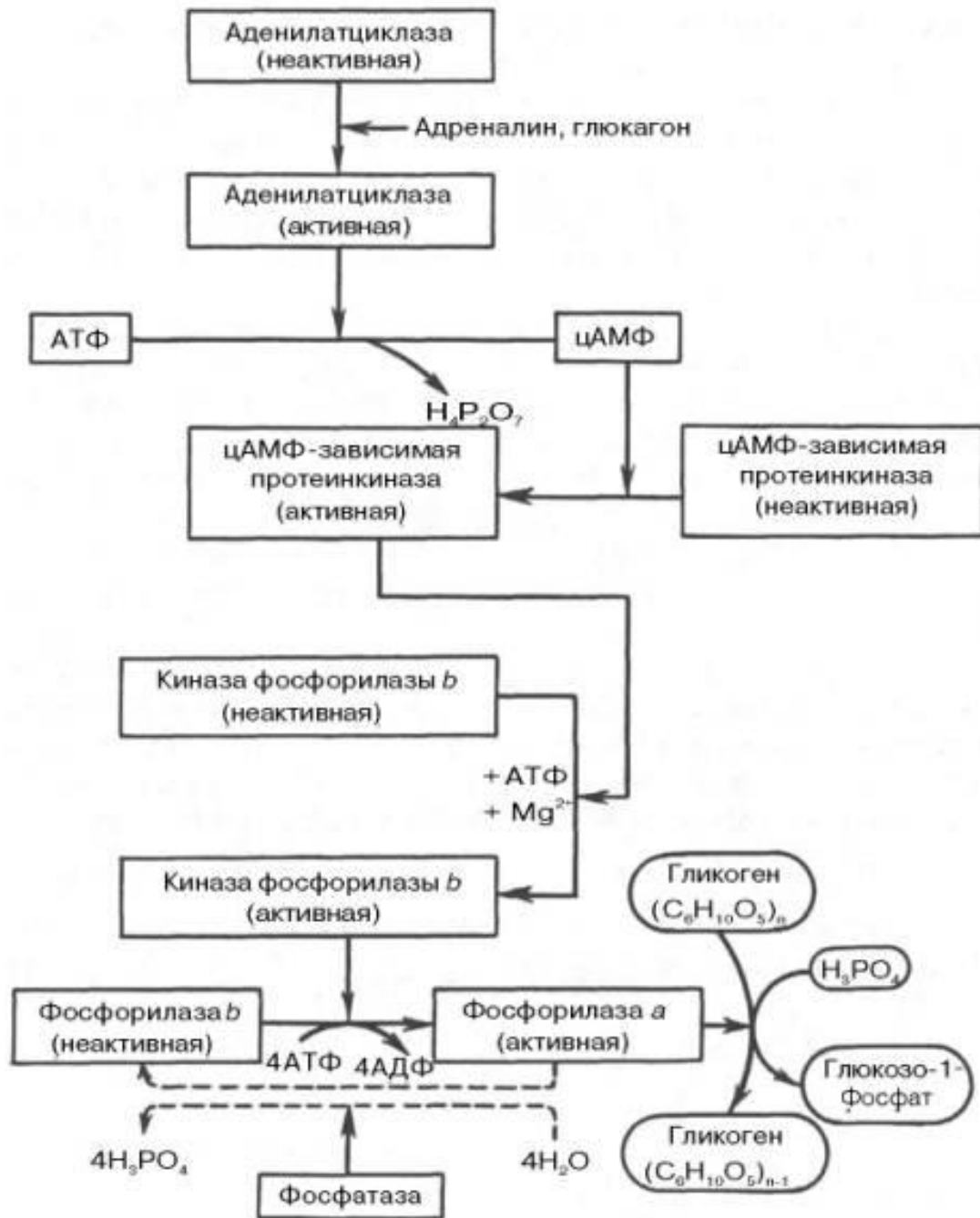
LE

GLUCOSE-6-PHOSPHA
TE



**LE
GLUCOSE-6-PHOSPHA
TE**

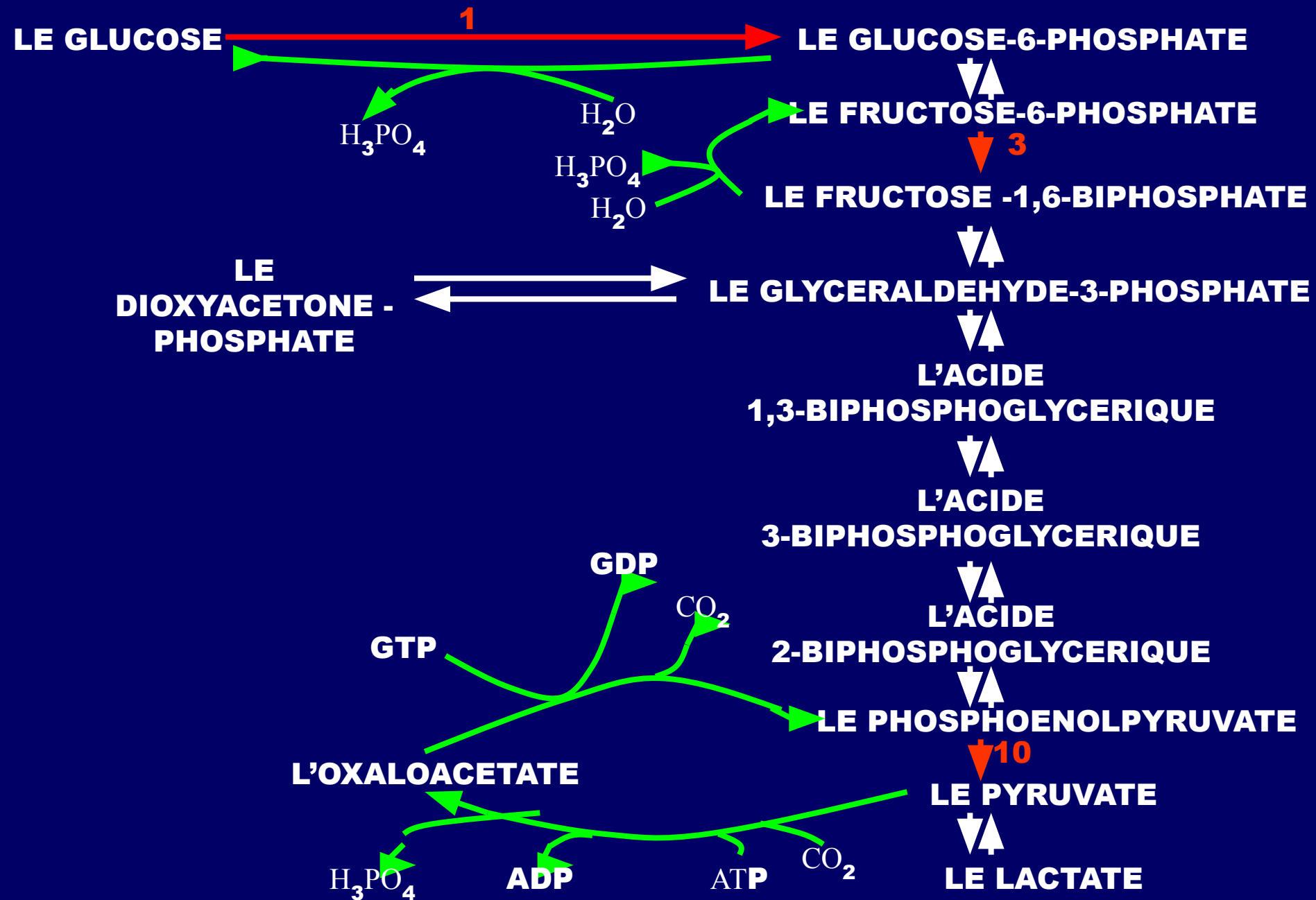
**LE
GLUCOSE**



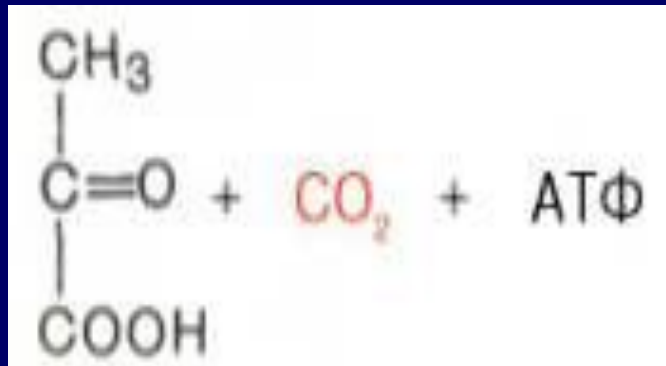
LES MALADIES GLYCOGENIQUES

Дефект фермента		Тип болезни
Глюкозо-6-фосфатазы	—————→	1-й тип (болезнь <i>Гирке</i>)
Альфа-1,4- гликозидазы	—————→	2-й тип (болезнь <i>Помпе</i>)
Амило-1,6- гликозидазы	—————→	3-й тип (болезнь <i>Кори</i>)
гликогенветвящий фермент	—————→	4-й тип (болезнь <i>Андерсена</i>)
Гликогенфосфорилазы миоцитов	—————→	5-й тип (болезнь <i>Мак-Ардля</i>)
Гликогенфосфорилазы гепатоцитов	—————→	6-й тип (болезнь <i>Гирса</i>)
Фосфоглюкомутазы	—————→	7-й тип (болезнь <i>Томпсона</i>)
Фосфофруктомутазы	—————→	8-й тип (болезнь <i>Таруи</i>)
Киназы фосфорилазы в гепатоцитах	—————→	9-й тип (болезнь <i>Хага</i>)

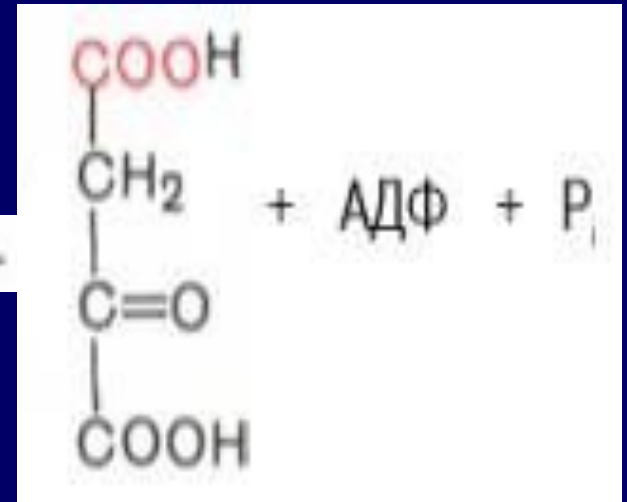
LA GLYCOLYSE ET LA GLYCONEOGENESE



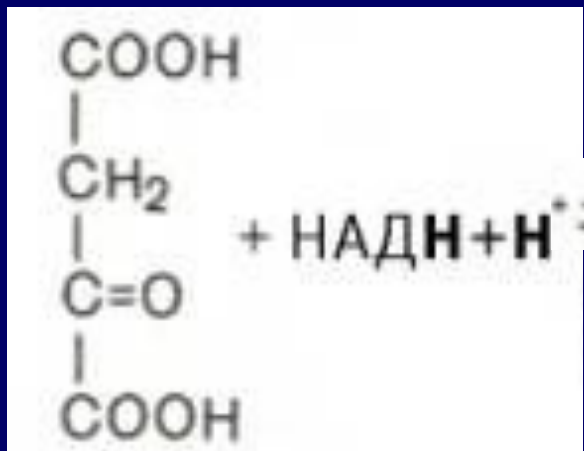
LA PYRUVATE CARBOXYLASE



L'ACIDE PYRUVIQUE



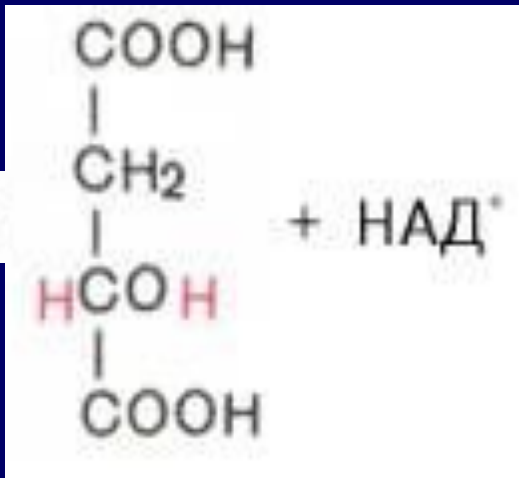
L'OXALOACETATE



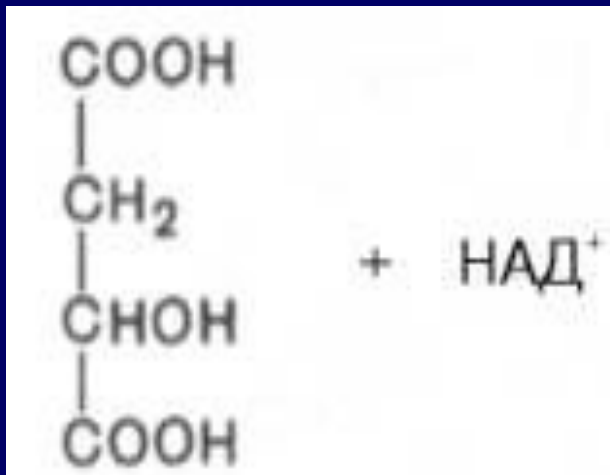
L'OXALOACETATE



**LA MALATE
DESHYDROGEN
ASE
(MITOCHONDRI
ALE)**



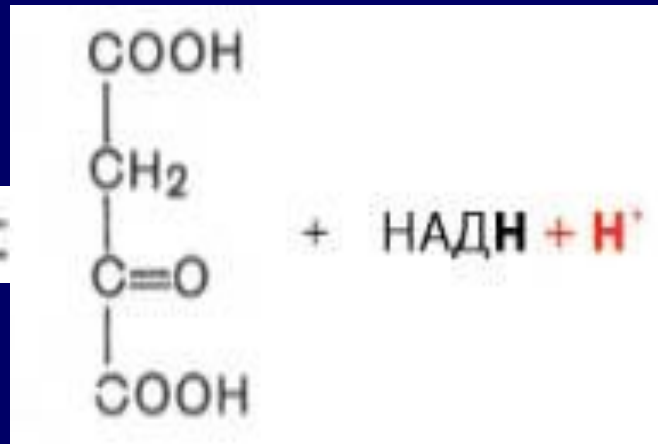
LE MALATE



LE MALATE

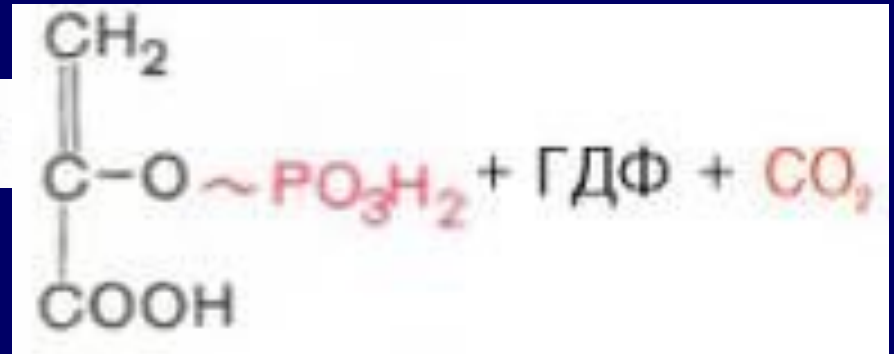
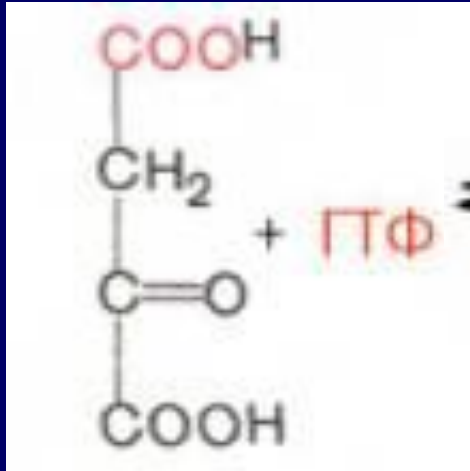


**LA MALATE
DESHYDROGE
NASE
(CYTOPLASMI
QUE)**



L'OXALOACETATE

LA PHOSPHOENOLPYRUVATE CARBOXYLASE



L'OXALOACETATE

LE PHOSPHOENOLPYRUVATE

**LE FRUCTOSE-
1,6-BIPHOSPHAT
E**

+ H₂O



**LE FRUCTOSE-
6-PHOSPHATE + P_i**

**LA FRUCTOSE
BIPHOSPHATASE**

**LE GLUCOSE-
6-PHOSPHATE**

+ H₂O

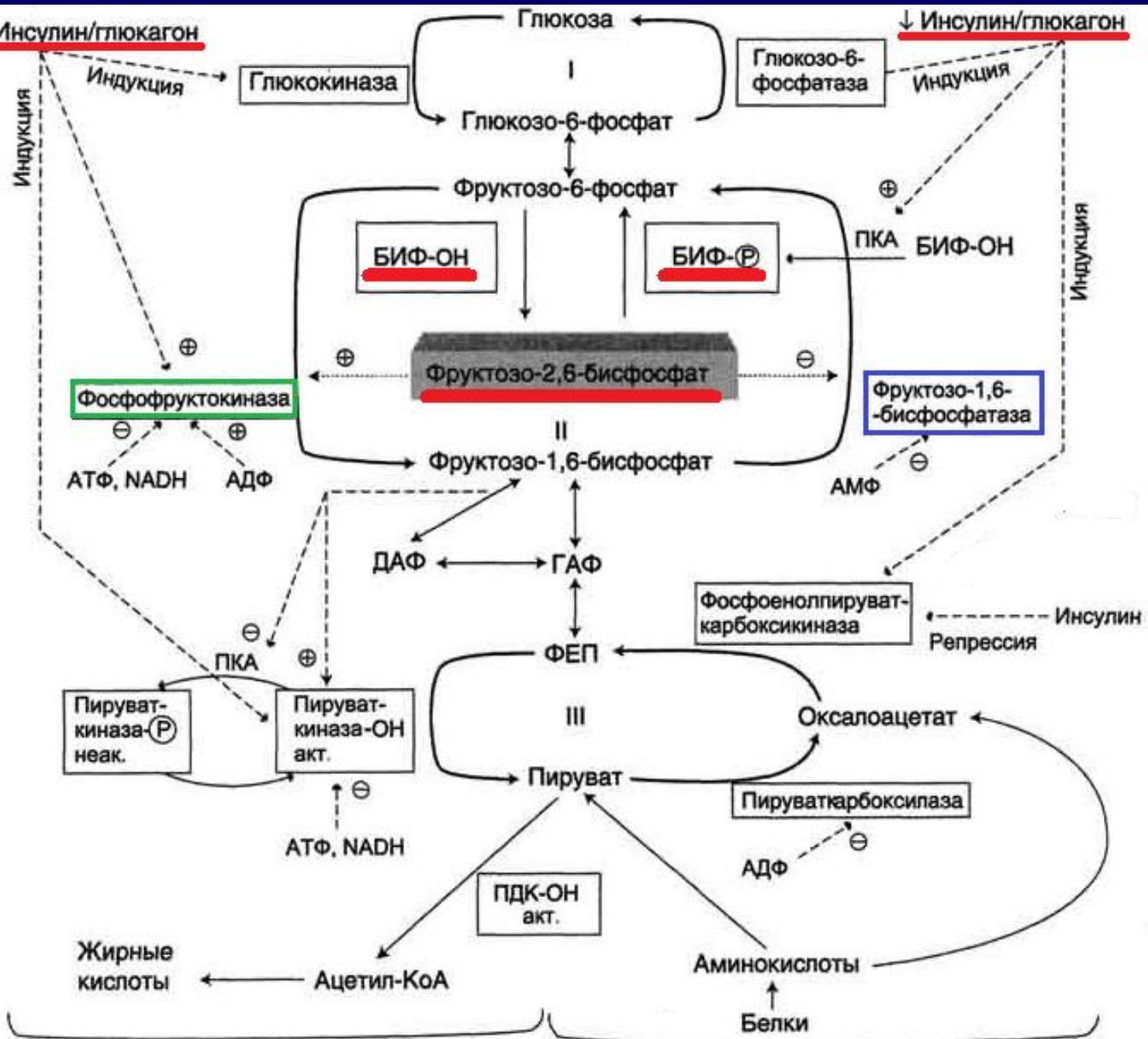


LE GLUCOSE + P_i

**LA GLUCOSE-
6-PHOSPHATASE**

↑ Инсулин/глюкагон

↓ Инсулин/глюкагон

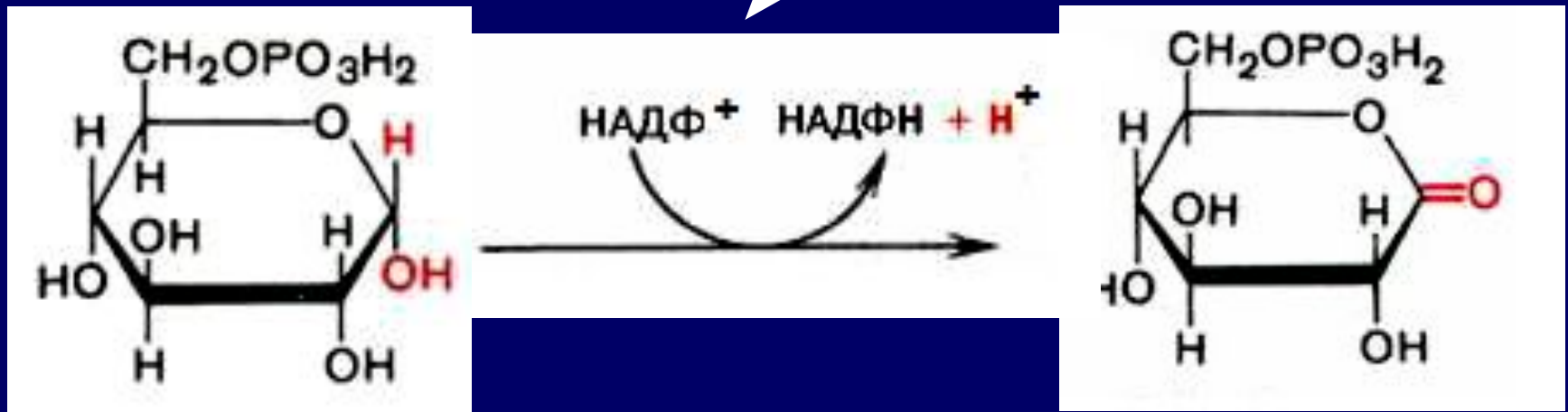


Гликолиз и синтез жиров

Глюконеогенез

LA VOIE DES PENTOSE PHOSPHATES DE LA TRANSFORMATION DU GLUCOSE LA VOIE OXYDATIVE

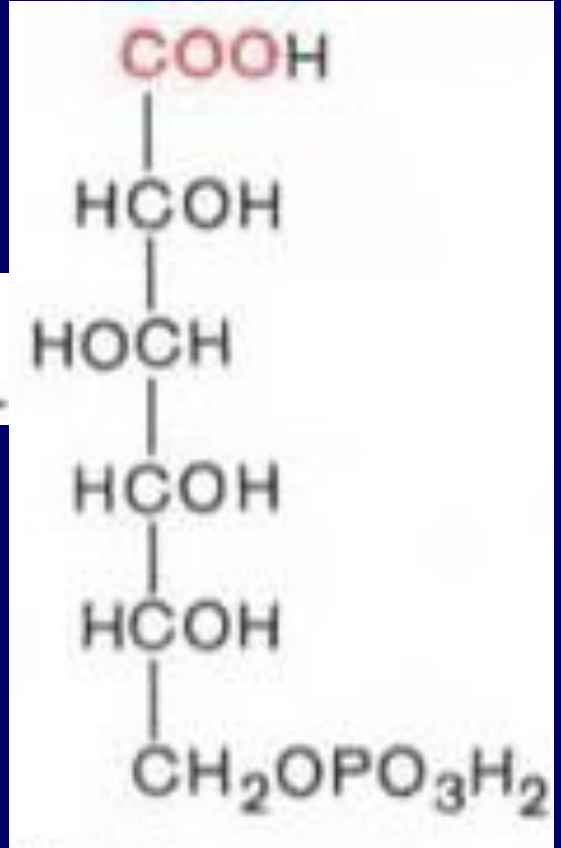
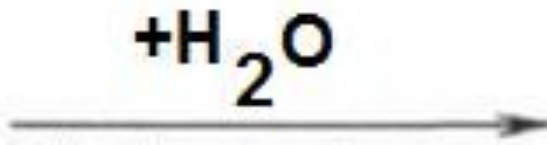
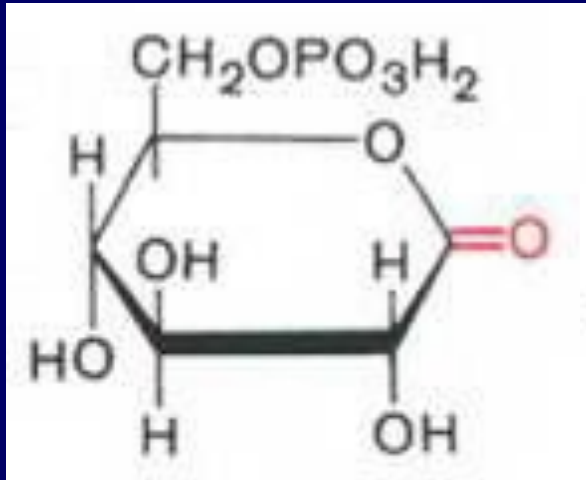
LA GLUCOSE-6-PHOSPHATE DESHYDROGENASE



**LE
GLUCOSE-6-PHOSP
HATE**

**LA
6-PHOSPHOGLUCON
O-**

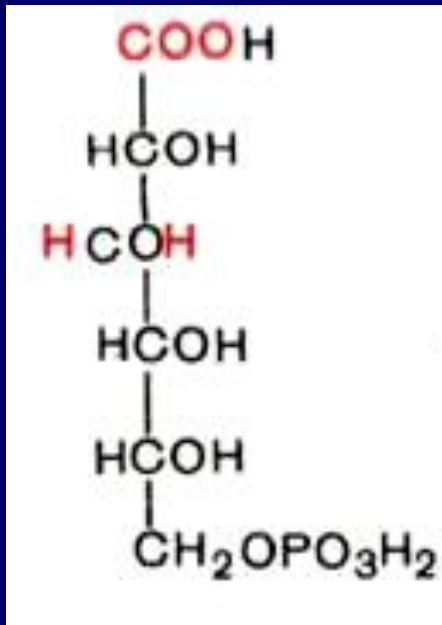
LA 6-PHOSPHOGLUCONO- LACTONASE



LA
6-PHOSPHOGLUCONO
-
δ-LACTONE

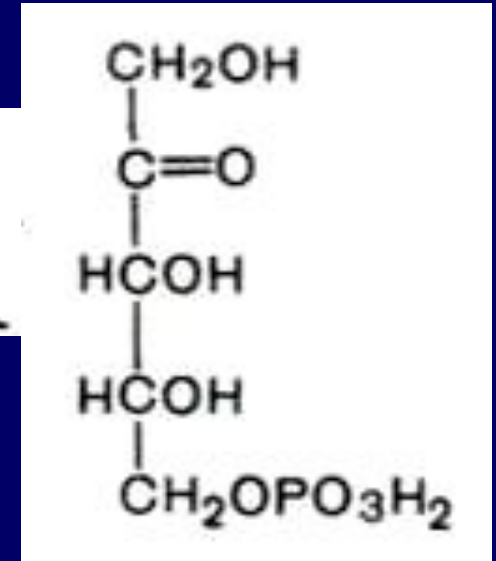
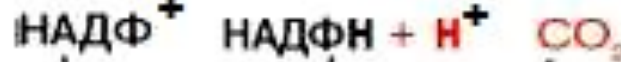
LE
PHOSPHOGLUCONATE

LA 6- PHOSPHOGLUCONATE DESHYDROGENASE (DECARBOXYLEE)



LE 6-

PHOSPHOGLUCONATE

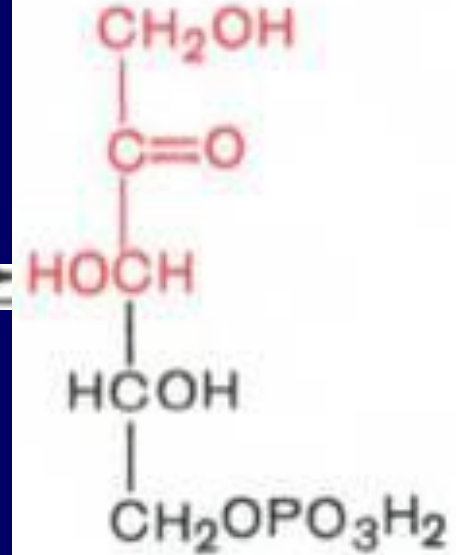
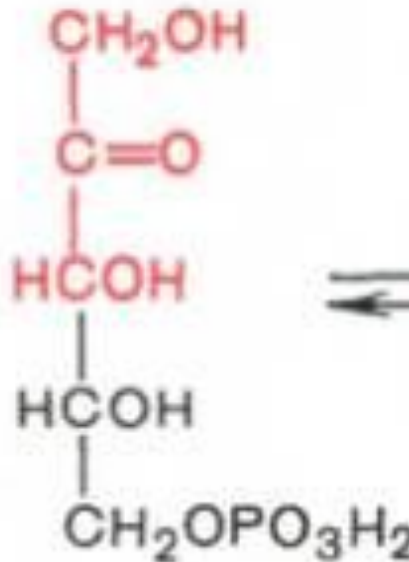
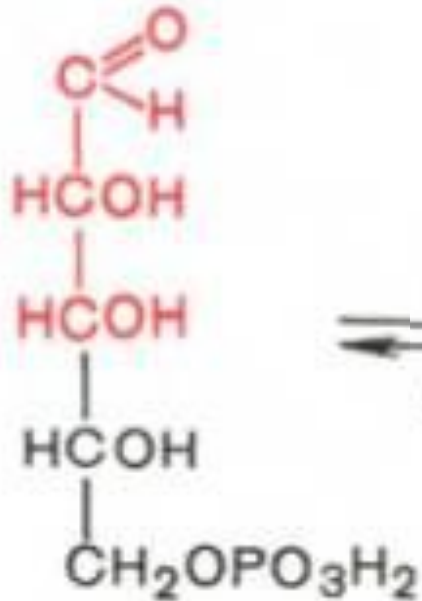


LE

RIBULOSE-5-PHOSPHATE

L'ISOMERASE

L'EPIMERASE



**LE RIBOSE-5-
PHOSPHATE**

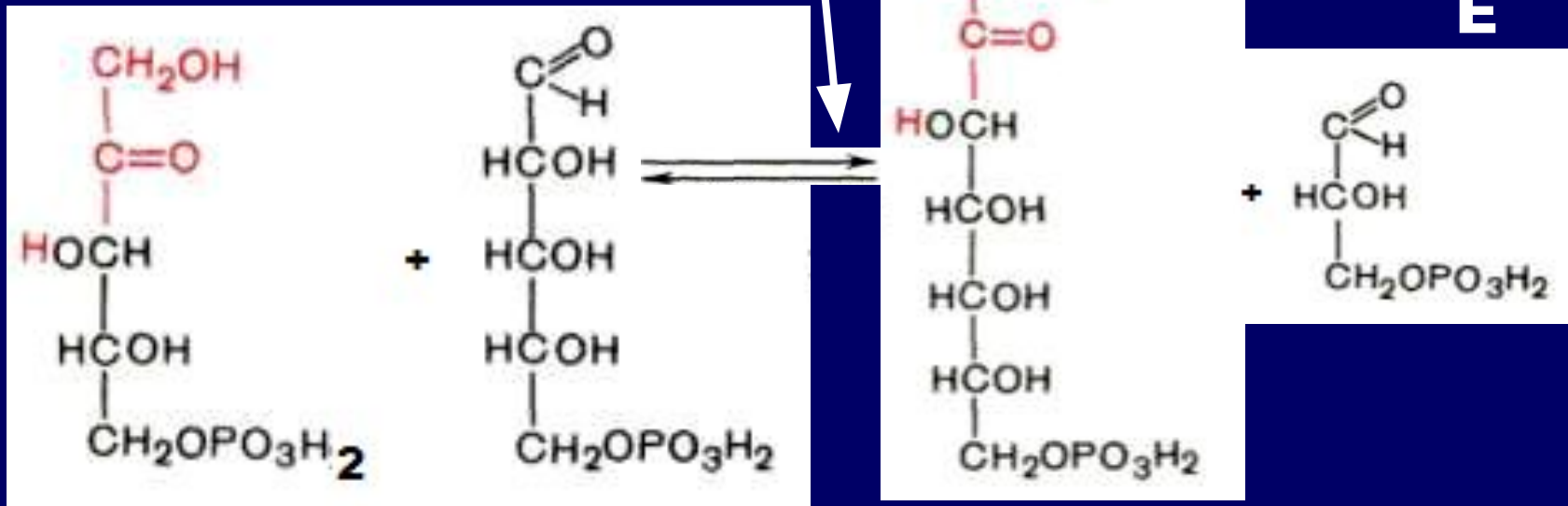
**LE
RIBULOSE-5-
PHOSPHATE**

**LE
XYLULOSE-5-
PHOSPHATE**

LA VOIE NON OXYDATIVE

LA TRANSCETOLASE

LE GLYCERALDEHYDE-3-PHOSPHATE



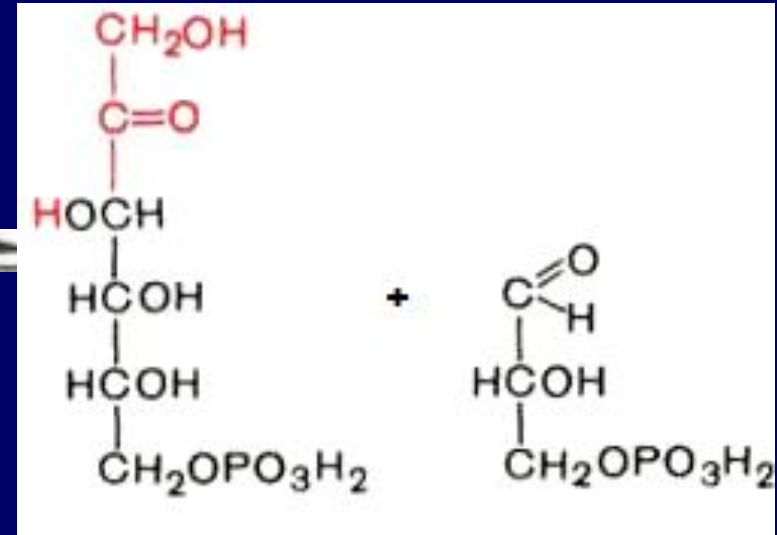
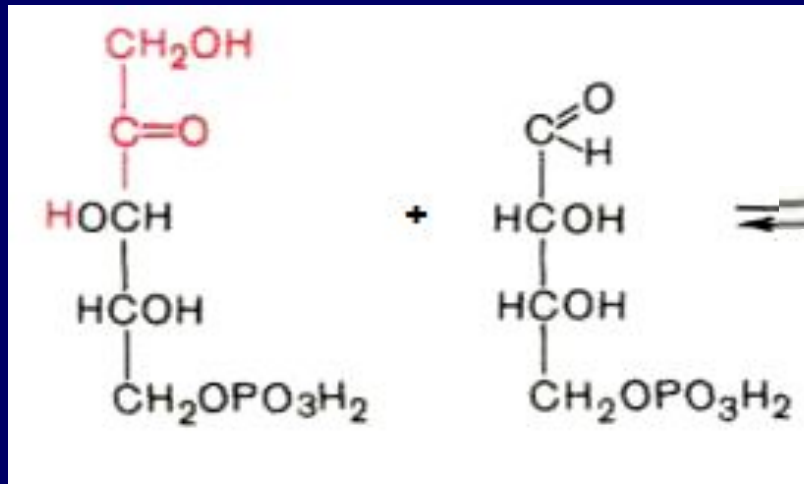
LE
**XYLULOSE-5-
PHOSPHATE**

LE
**RIBOSE-5-
PHOSPHATE**

LE
**SEDOHEPTULOSE-
7-PHOSPHATE**

LA TRANSCETOLASE

LE GLYCERALDEH YDE- 3-PHOSPHATE

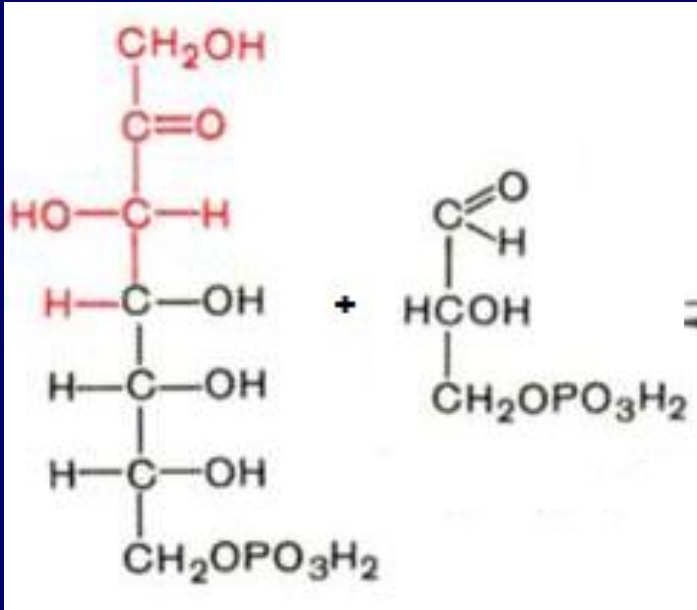


LE
XYLULOSE-5-
PHOSPHATE

L'ERYTHROSE-
4-PHOSPHATE

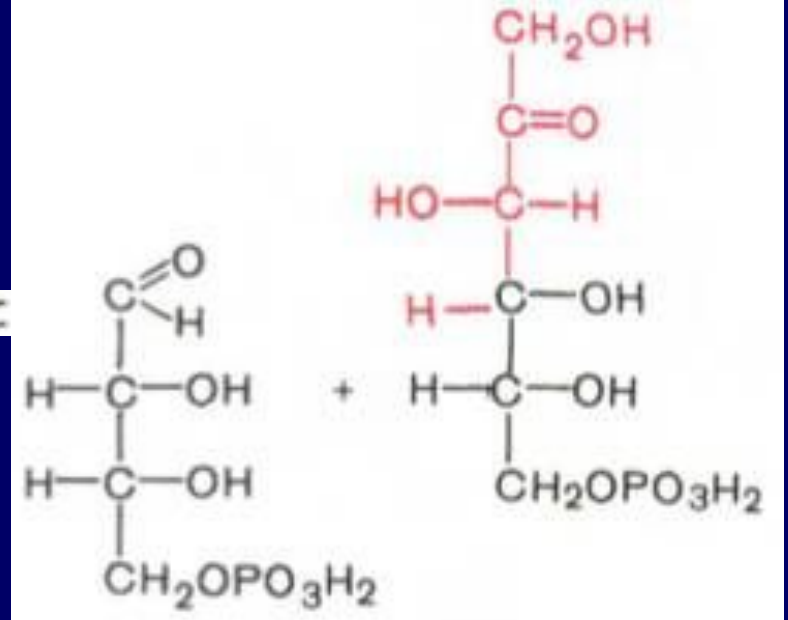
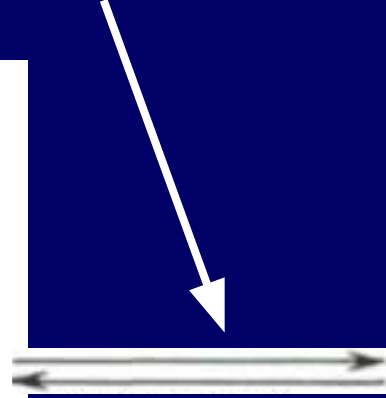
LE
FRUCTOSE-
6-PHOSPHATE

LA TRANSALDOLASE



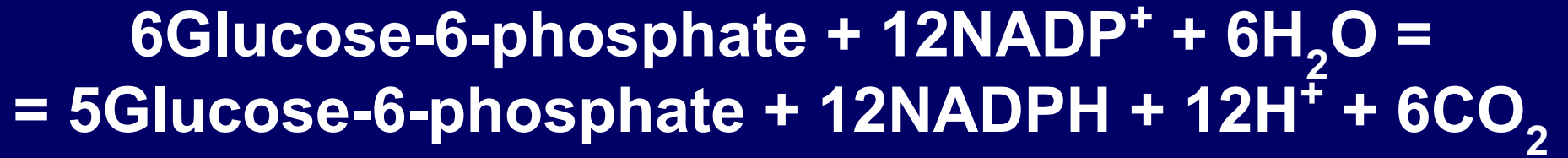
**LE
SEDOHEPTUL
OSE-
7-PHOSPHATE**

**LE
GLYCERALDEH
YDE-
3-PHOSPHATE**



**L'ERYTHROSE-
4-PHOSPHATE**

**LE FRUCTOSE-
6-PHOSPHATE**

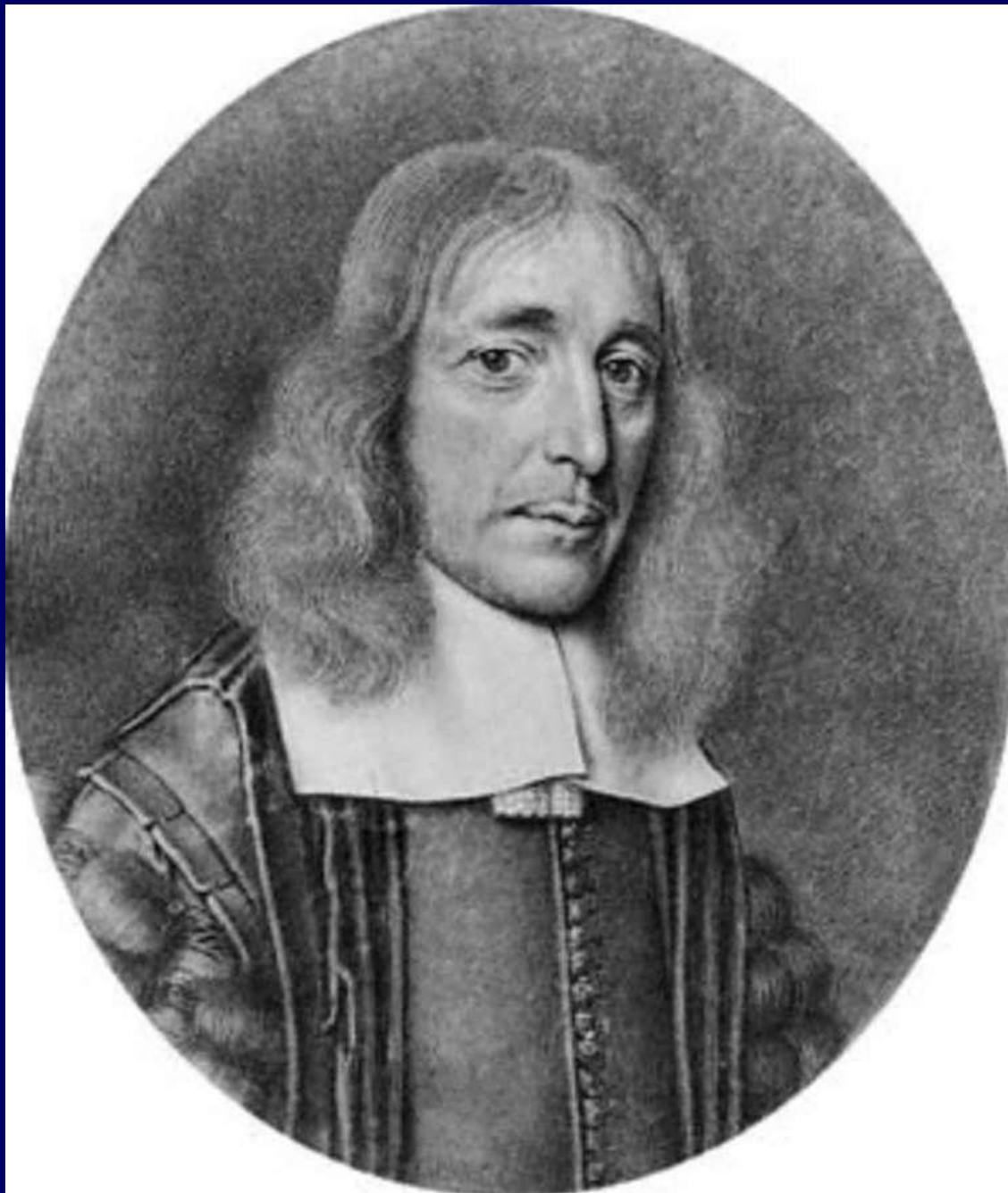


Поджелудочная железа



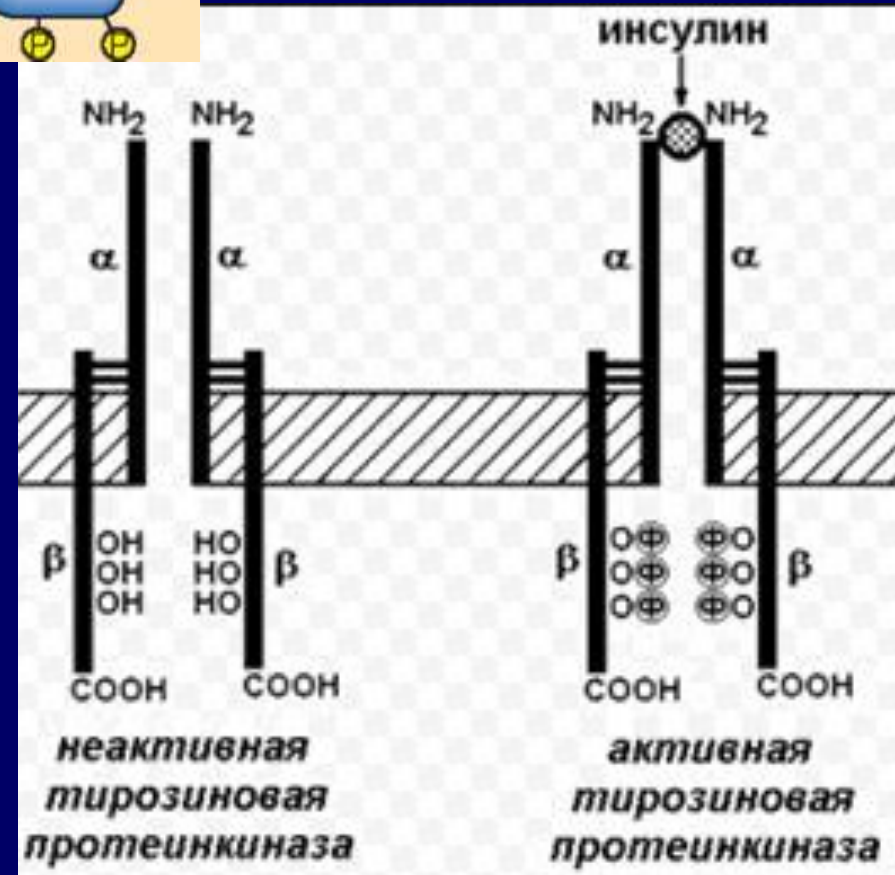
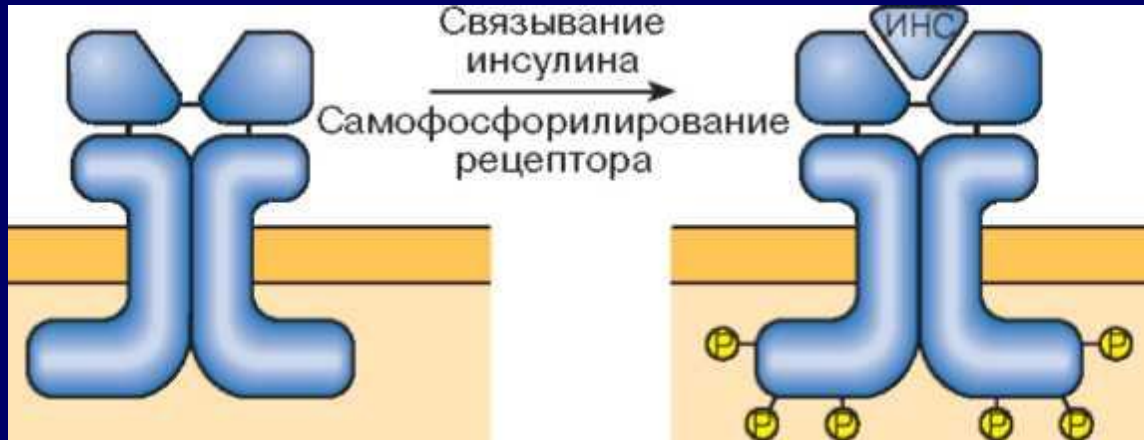
ARETEE DE CAPPADOCE (II S. a.p. J.C.)





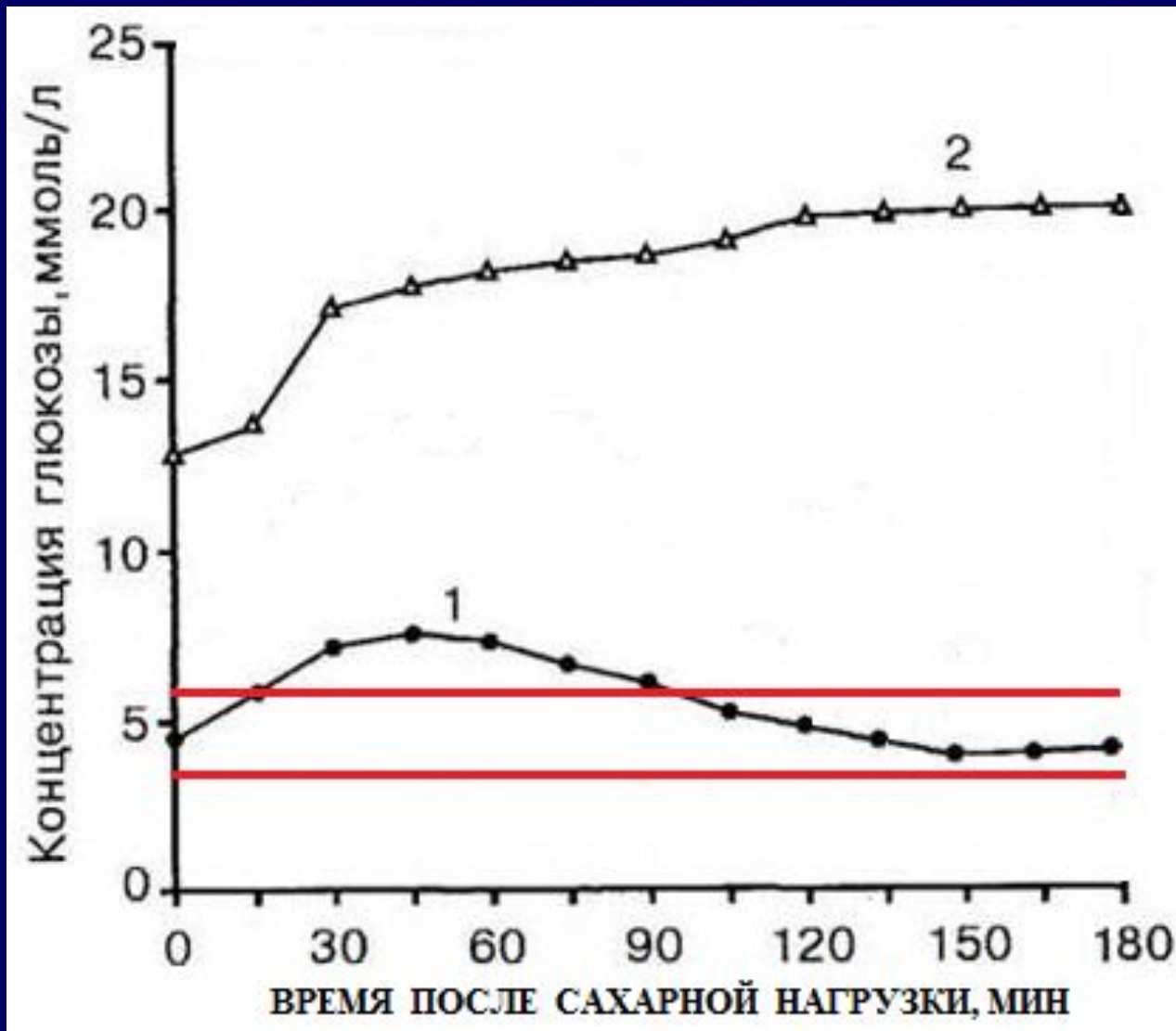
**THOMAS
WILLIS
(XVII S.)**

LE RECEPTEUR DE L'INSULINE

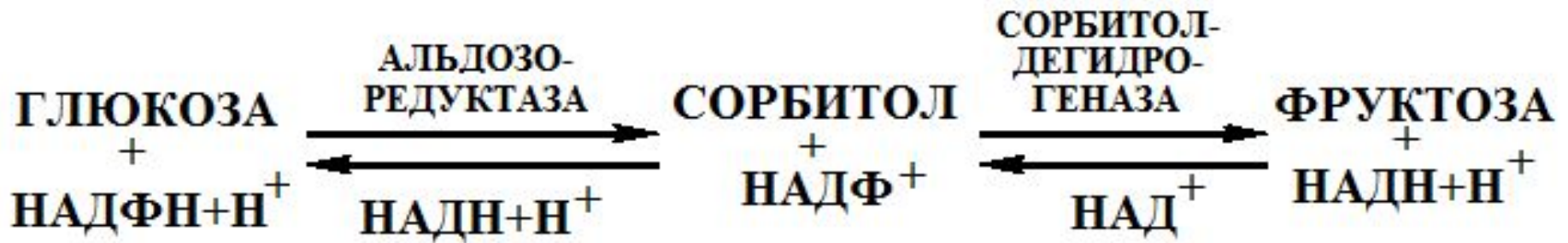




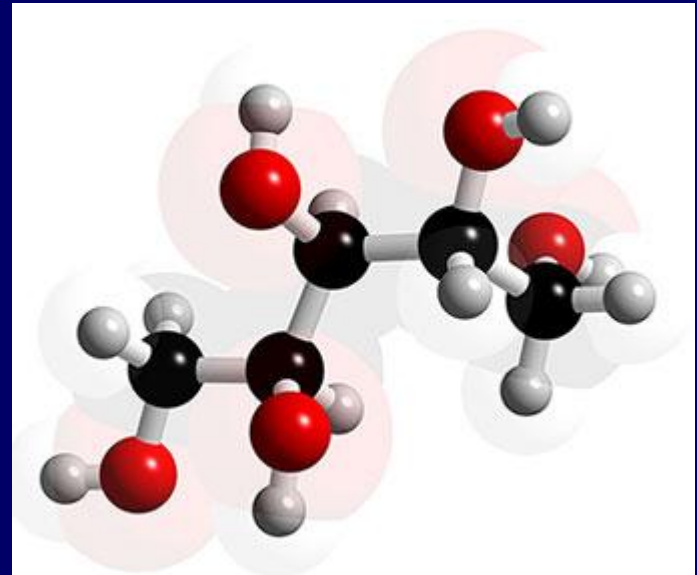
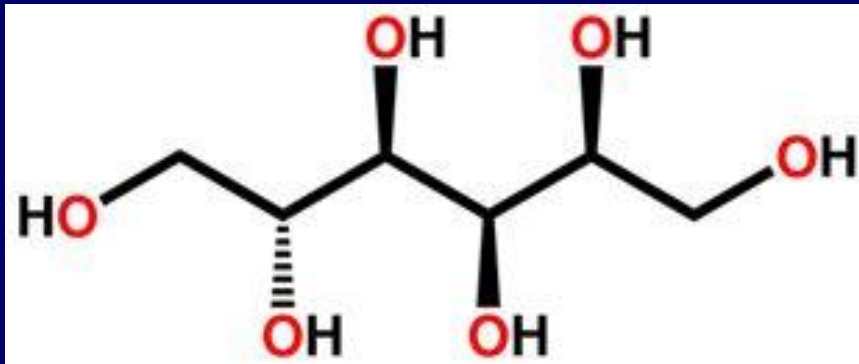
LA COURBE GLYCEMIQUE EN ETAT NORMAL (1) ET LORS DU DIABETE SUCRE (2)



LE SHUNT DE SORBITOL



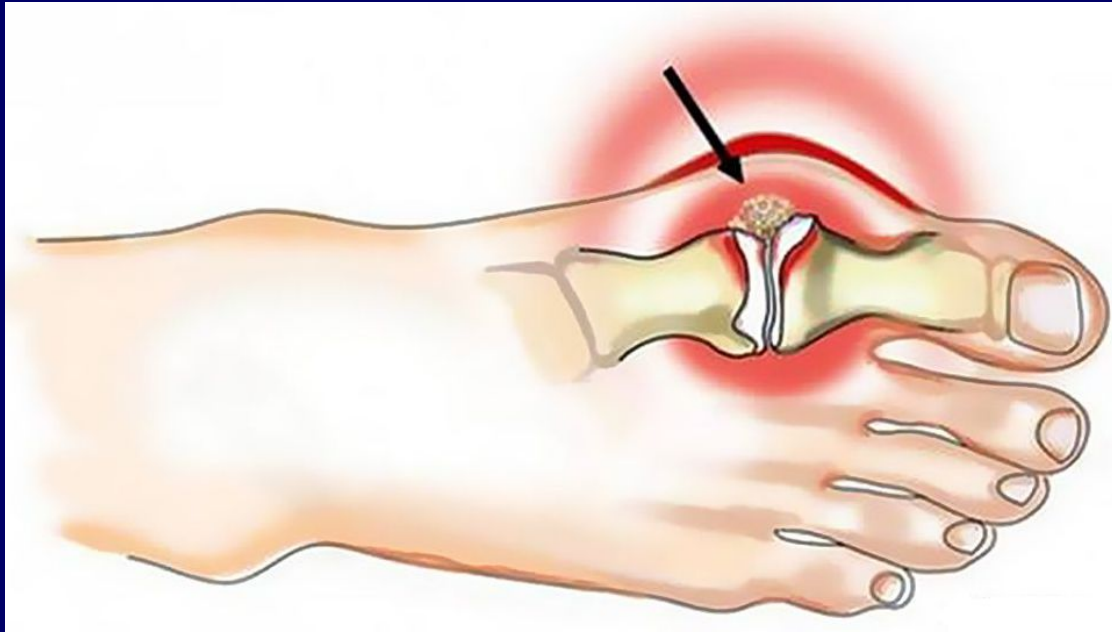
LE SORBITOL



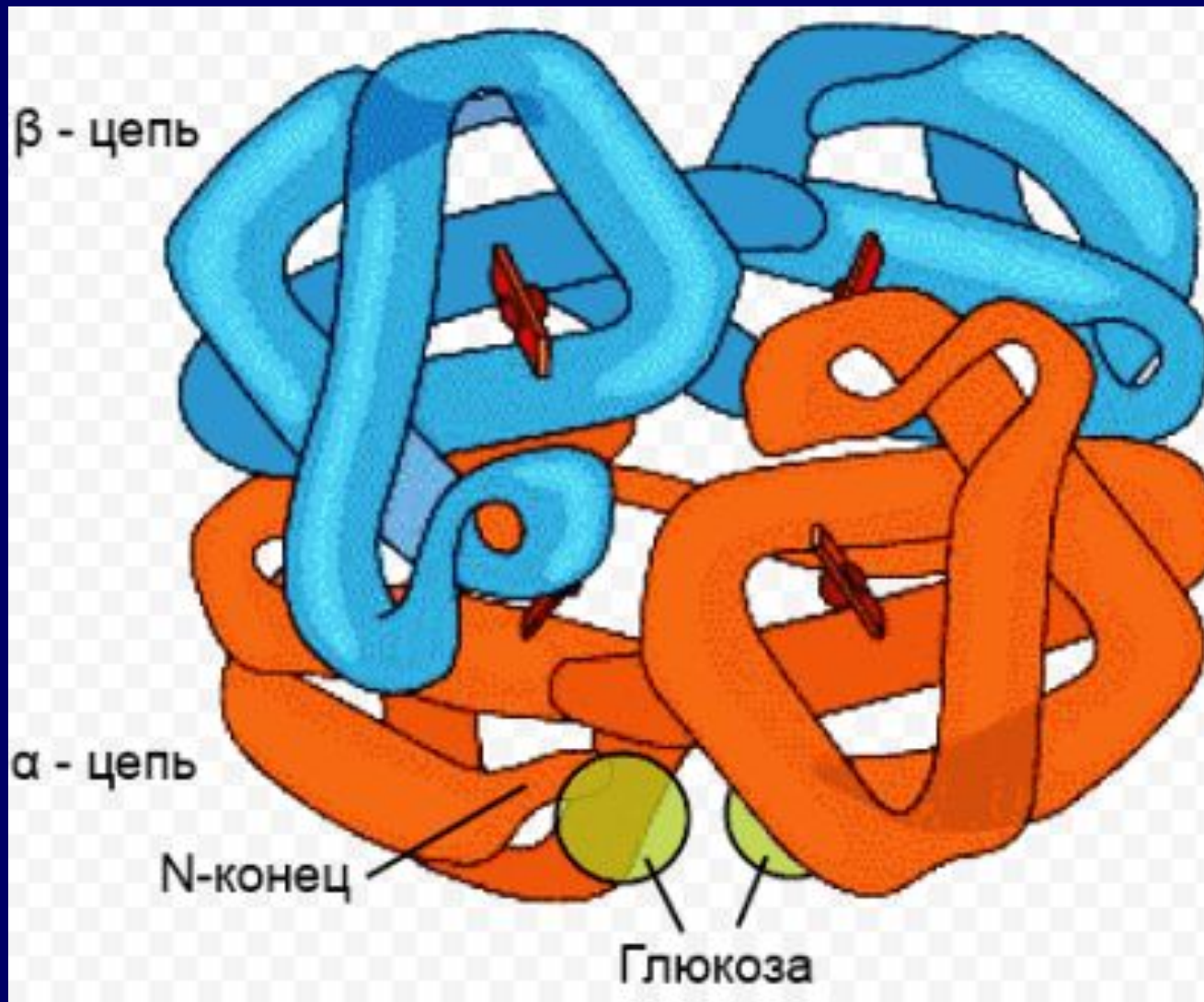
LA NEUROPATHIE DIABETIQUE



L'ARTHROPATHIE DIABETIQUE



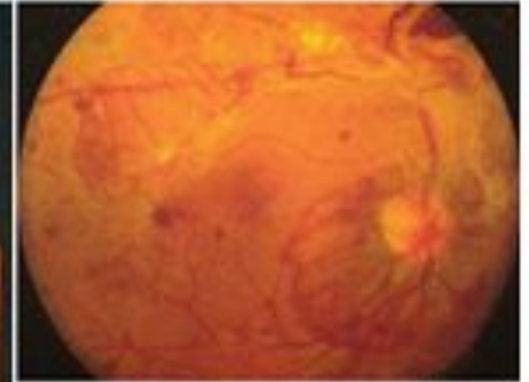
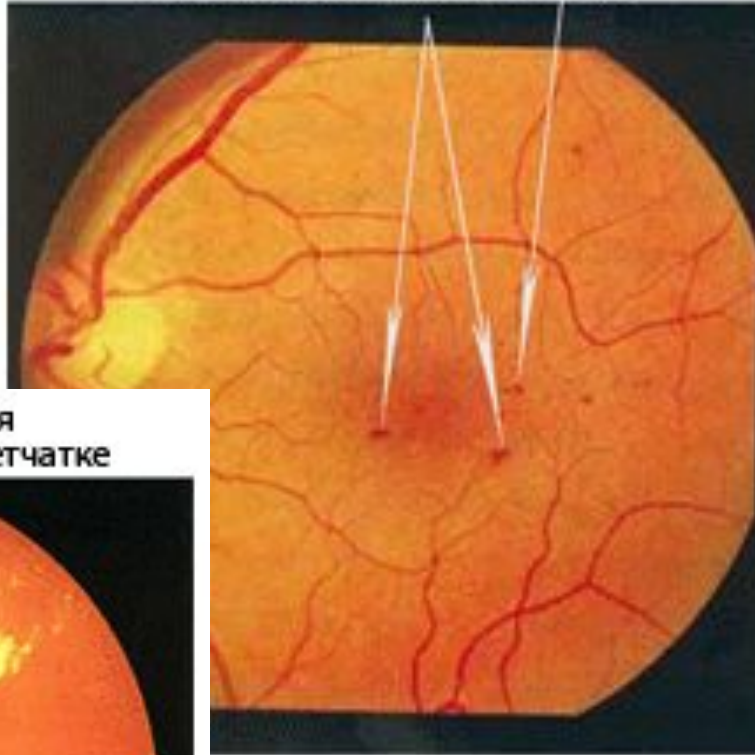
L'HEMOGLOBINE GLYQUEE (HbA1C)



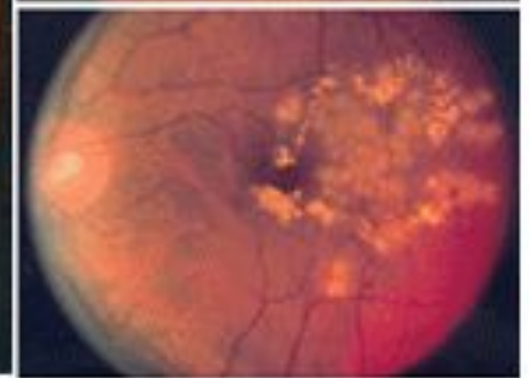
HbA1C (%)	Средний уровень глюкозы крови (mmol/L)
4	2,6
5	4,5
6	6,7
7	8,3
8	10,0
9	11,6
10	13,3
11	15,0
12	16,7

LA RETINOPATHIE DIABETIQUE

кровоизлияние в сетчатке



патология разрастания
соединительной ткани на сетчатке



атрофия зрительных
клеток сетчатки