

Lipid Metabolism



أيض الدهون Lipid metabolism

تحتوي المواد الغذائية على كمية كبيرة من المركبات الكيميائية الدهنية وتشمل: **Phospholipids و Triglycerides و Cholesterol** وبعض المركبات الدهنية الأقل أهمية.

يحتوي ثلاثي الجليسرأيد و الفوسفوليبيدات على كمية كبيرة من الأحماض الدهنية أما الكولسترول بالرغم من أنه لا يحتوي على حمض دهني إلا أن نواته الأستريولية تبنى من نواتج هدم جزيئات الأحماض الدهنية ولذلك فكثير من خواصه الفيزيائية والكيميائية تشبه الدهون.

اهمية الدهون:

تستخدم الجليسرأيدات في امداد خلايا الجسم بالطاقة المطلوبة لمختلف النشاطات الأيضية وهي تشترك مع المركبات الكربوهيدراتية في هذه الأهمية

ومع ذلك فالدهون عامة و الفوسفوليبيدات خاصة و الكولسترول تلعب وظائف هامة أخرى تشمل البناء الهيكلي للأغشية و العضيات و الارتباط مع البروتينات التركيبية والوظيفية مثل الإنزيمات و النواقل و الإنتيجينات و المستقبلات.

FATTY ACID METABOLISM

- ❖ A **fatty acid** is a carboxylic acid.
- ❖ often with a long unbranched aliphatic chain, which is either saturated or unsaturated.
- ❖ Carboxylic acids as short as butyric acid (4 carbon atoms) are considered to be fatty acids,
- ❖ Fatty acids are produced by the hydrolysis of the ester linkages in a fat or biological oil (both of which are triglycerides), with the removal of glycerol.
- ❖ The most abundant natural fatty acids have an even number of carbon atoms.

Overview

Fatty acids (F.A.s) are taken up by cells.

They may serve as:

- synthesis of other compounds
- fuels for energy production
- substrates for ketone body synthesis.

Ketone bodies may be exported to other tissues:
used for **energy production**.

Some cells **synthesize fatty acids** for storage or export.

Energy

Fats are an important source of calories.

fat.

Fat is the major form of **energy storage**.

Typical body fuel *reserves* are:

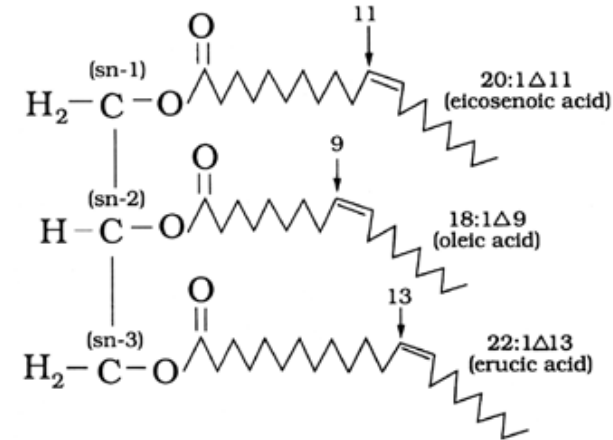
fat:	100,000 kcal.
protein:	25,000 kcal.
carbohydrate:	650 kcal.

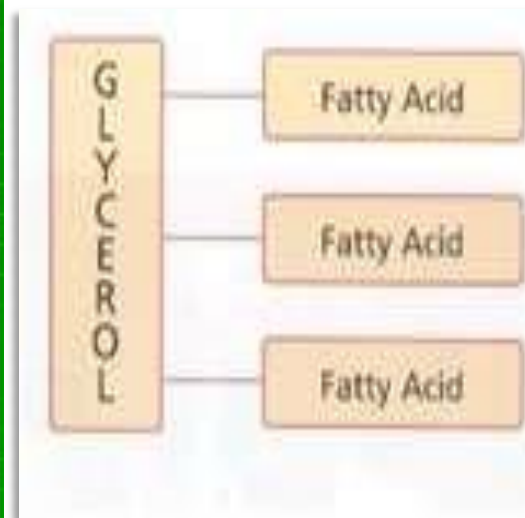
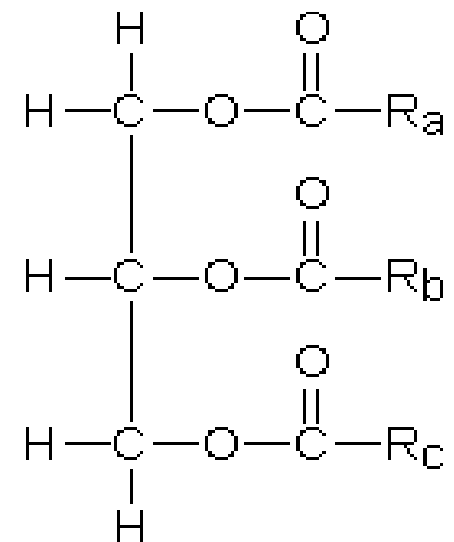
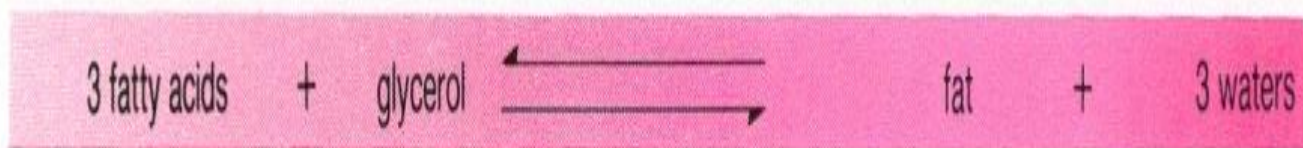
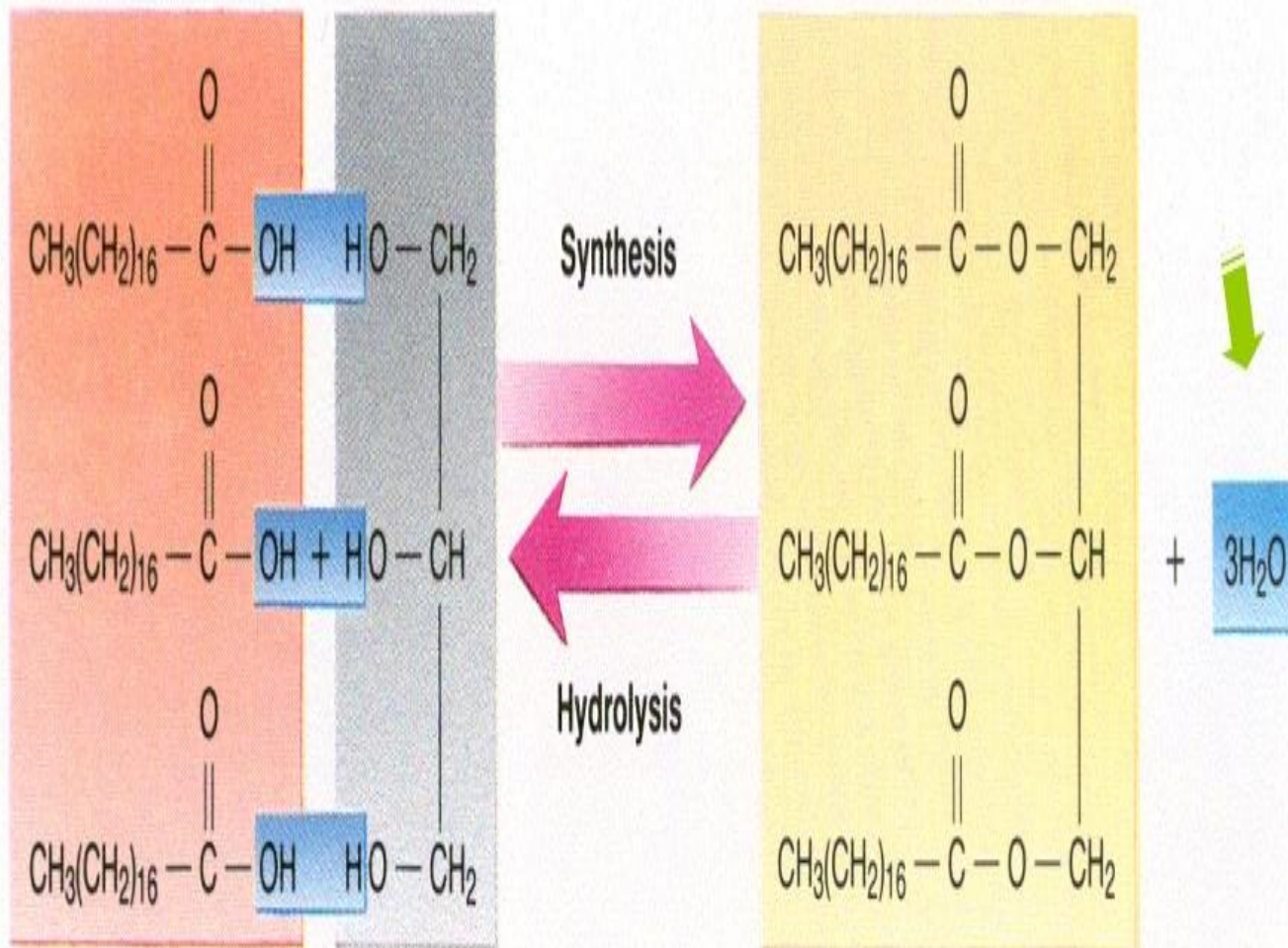
TAG reserves would enable someone to survive starvation for ~30 days

Digestion and Absorption of Lipids

- 98% of ingested lipids are triacylglycerols (TAGs)
 - Digestion in the Mouth:
enzymes are **aqueous**
- Digestion in the Stomach:
causes a large **physical**
change:
into droplets: **“Chyme”**

TRIACYLGLYCEROL

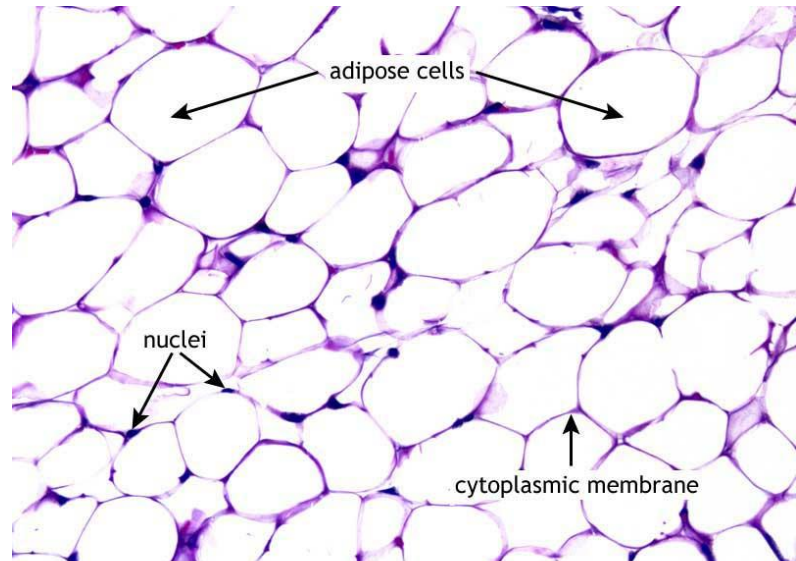
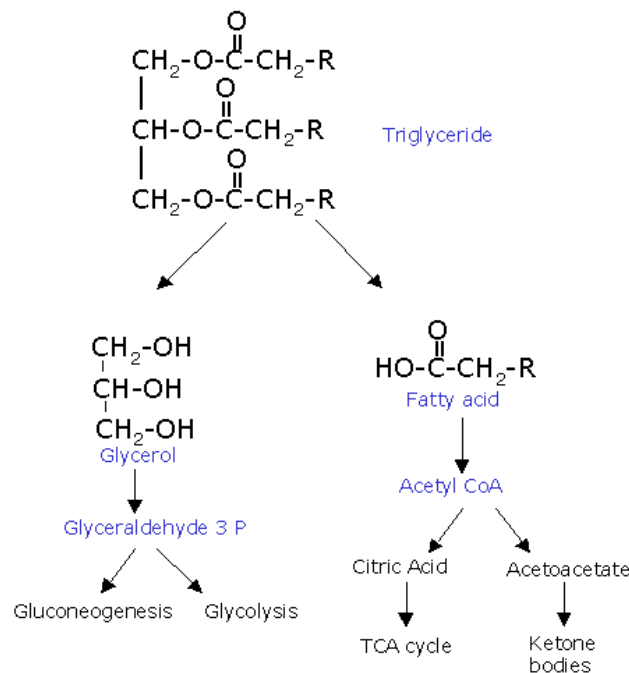




Triacylglycerols reach bloodstream
& are hydrolyzed down to **glycerol** and **fatty acids**.

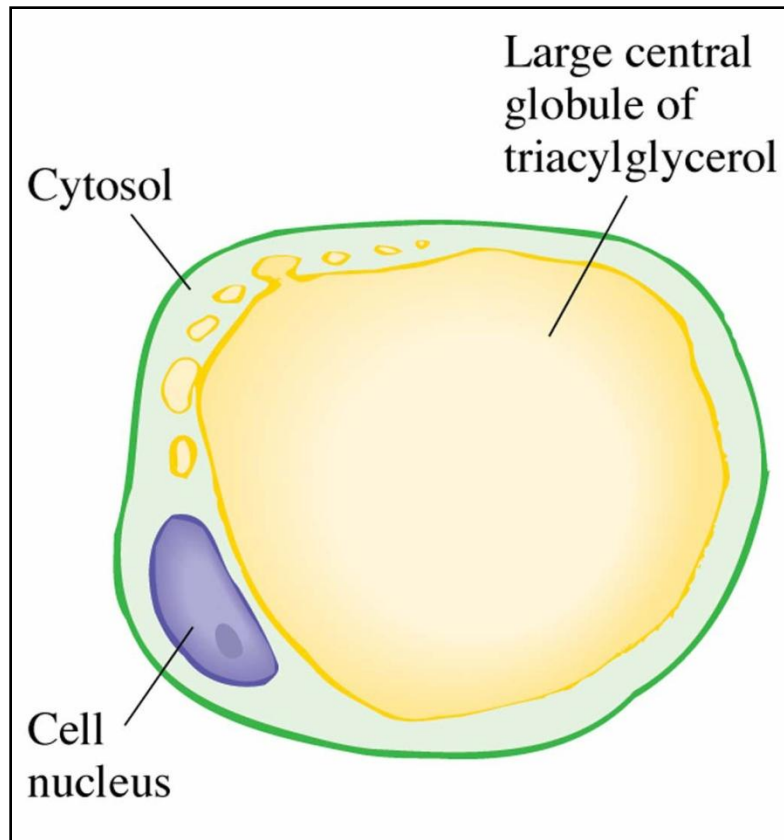
These are absorbed by cells and
processed further for energy by forming **acetyl CoA**.
or

Stored as lipids in fat cells (adipose tissue)

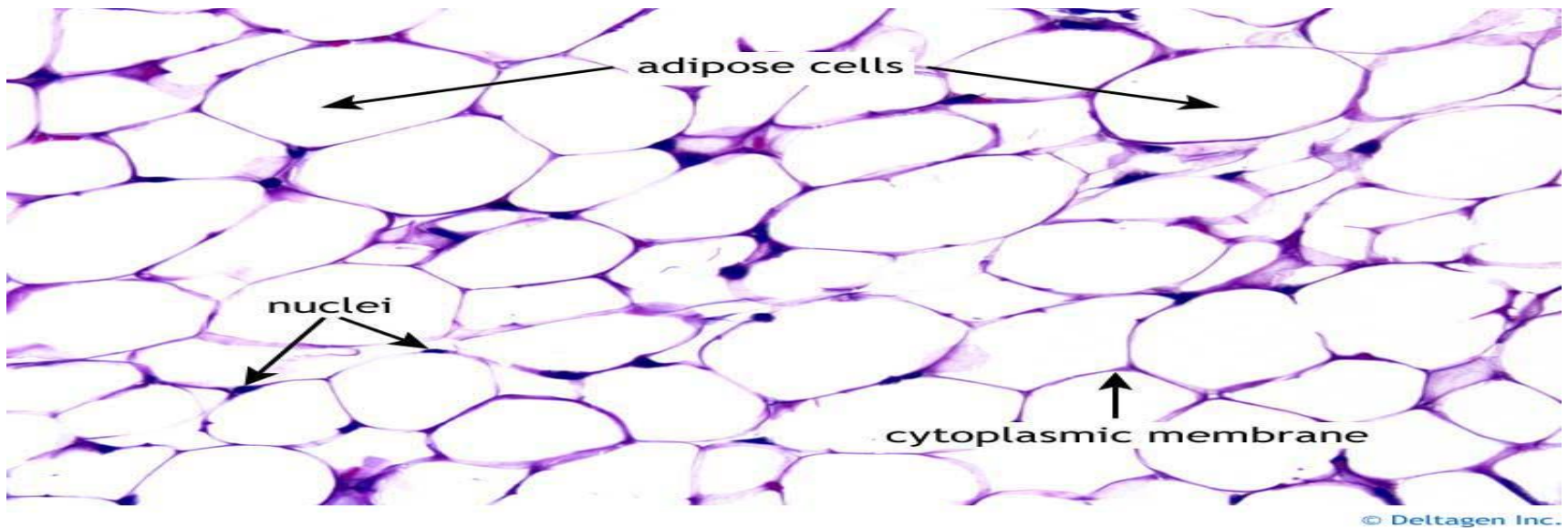


Triglyceride Storage

Storage of triacylglycerol is in **adipocytes**
Fatty acids stored primarily as triacylglycerol.



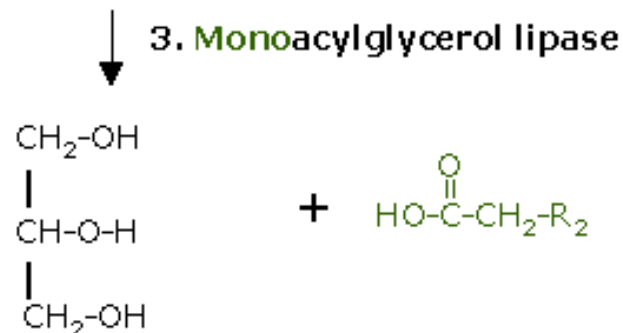
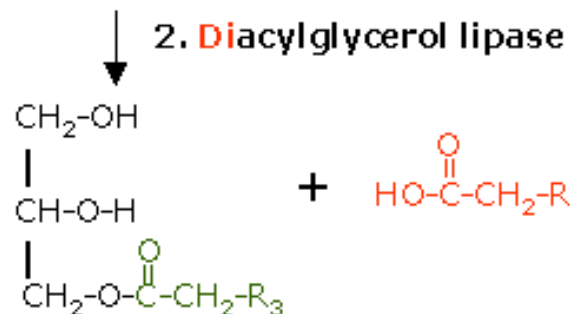
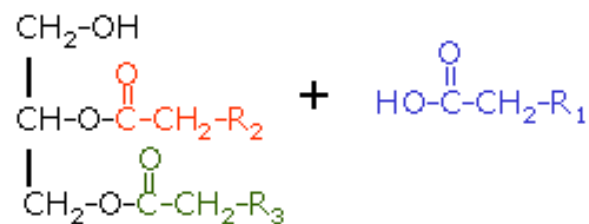
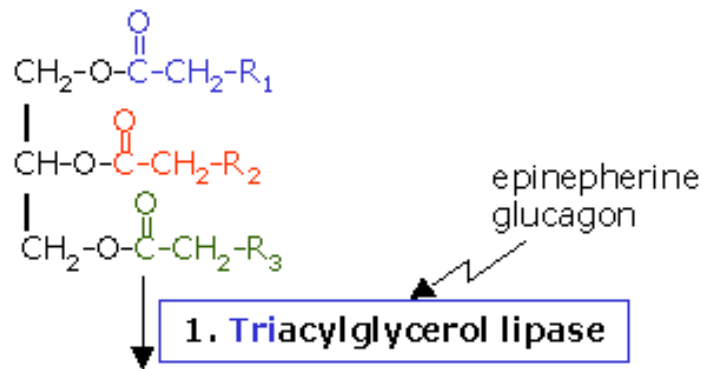
Triacylglycerol
is **hydrolyzed**
to release
fatty acids
when needed.



Adipocytes are found mostly in the abdominal cavity and subcutaneous tissue.

Store **energy**, **insulation** against heat loss, **shock absorber** for organs.

Adipocytes are metabolically very active: triacylglycerol constantly hydrolyzed & re-synthesized.



TAGs hydrolyzed
to form fatty acids.

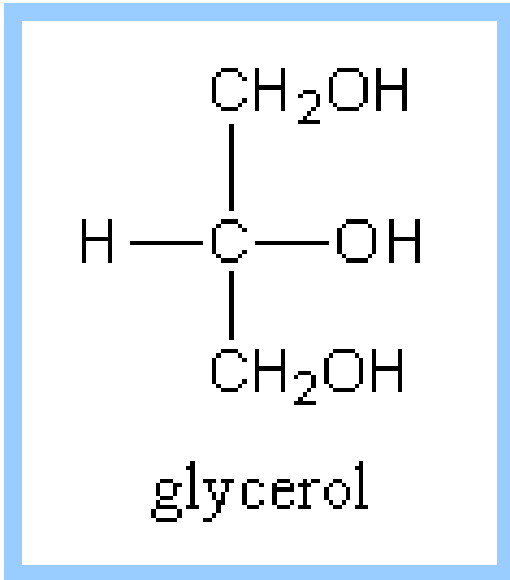
Triacylglycerol lipase

Diacylglycerol lipase

Monoacylglycerol lipase

Only triacylglycerol lipase is
activated by epinephrine.

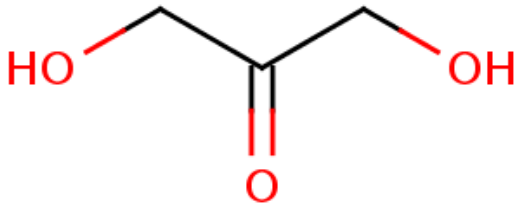
Glycerol Metabolism



One glycerol formed for each TAG hydrolyzed.

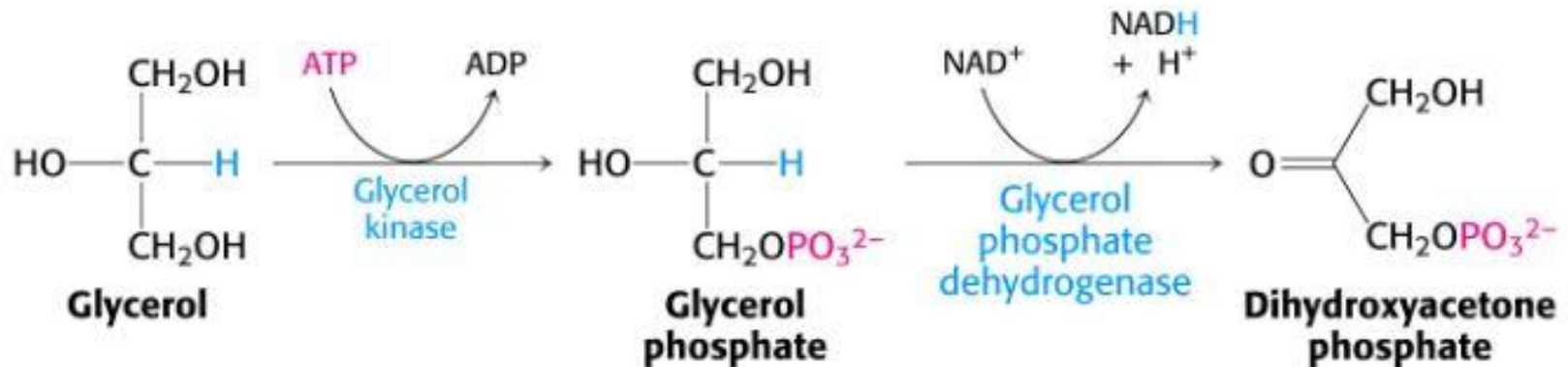
Enter bloodstream & go to liver or kidneys for processing.

Converted in 2 steps to
Dihydroxyacetone phosphate



Where will the phosphate be attached?

Uses up one ATP
Reduces one NAD⁺ to NADH



Primary hydroxyl
group is
phosphorylated

Oxidized to
form a
Ketone

Dihydroxyacetone phosphate

is an intermediate for both

Glycolysis:

converted to Pyruvate, then to Acetyl CoA, & eventually to CO_2 , releasing its energy.

Gluconeogenesis:

creates Glucose from **non-carbohydrate** source

Lipid metabolism & carbohydrate metabolism
are connected.