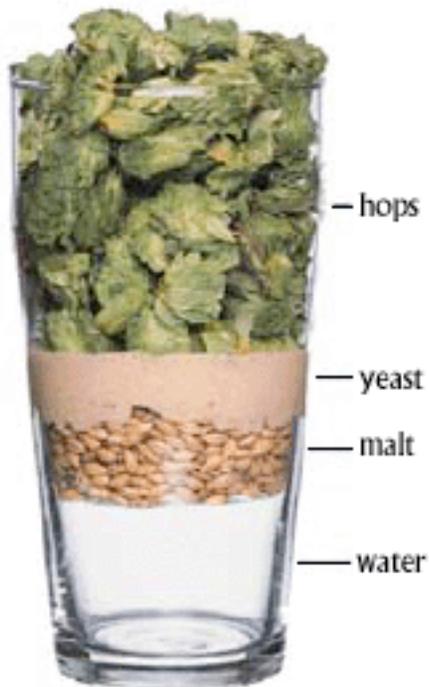


Practice Question

If the liver cells of an animal have 24 chromosomes, how many chromosomes do its sperm cells have?

- A) 6
- B) 12
- C) 64
- D) 24
- E) 48

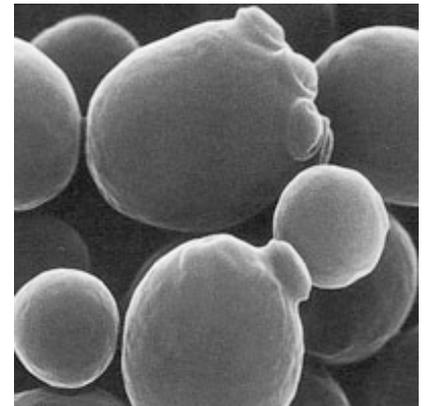
Glycolysis and Fermentation



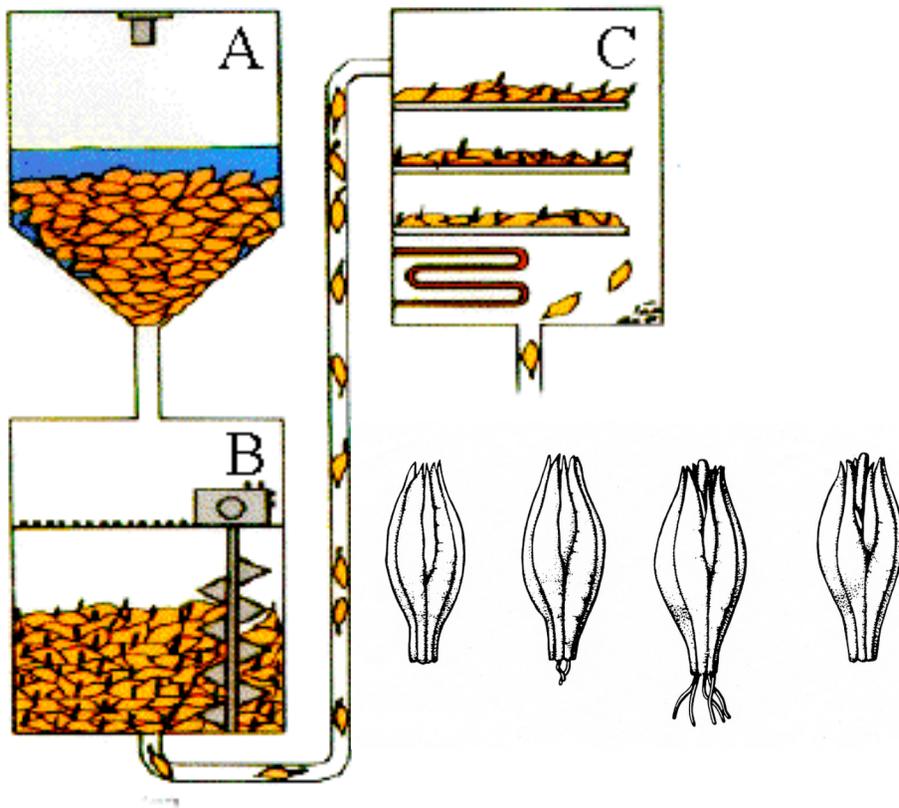
The Ingredients
of British Beer

A biochemist's guide to brewing
and the pathways that get you
there!

Saccharomyces cerevisiae



Barley



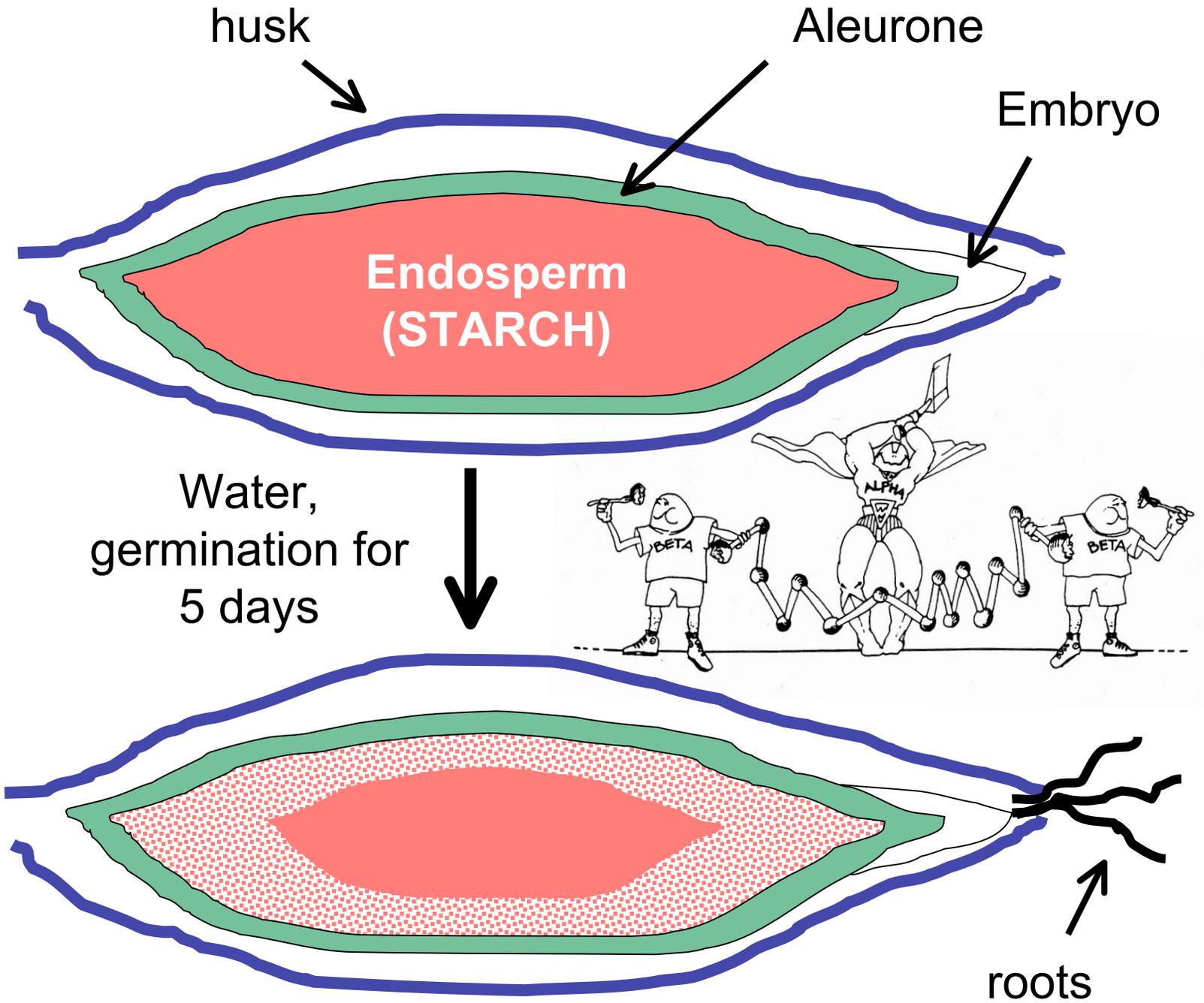
A: Steeping Vessel
water uptake

B: Malting Beds
initiate germination

C: Kiln
Drying/roasting barley

You now have Malt!

Malting





Mashing/Wort



D: Mill

grinds up malt

E: Mashing Tank

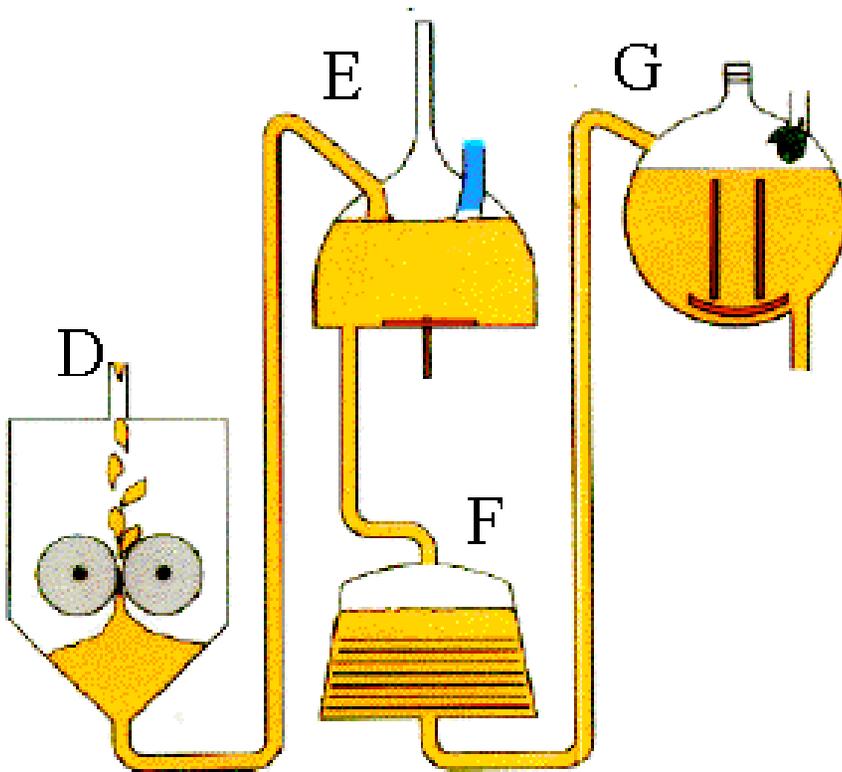
Starch broken down to sugars

F: Filters

removes spent grains

G: Wort Kettle

Boiling "wort", sterilization etc.



Hops: *Humulus lupulus*



Pitching Yeast--Fermentation



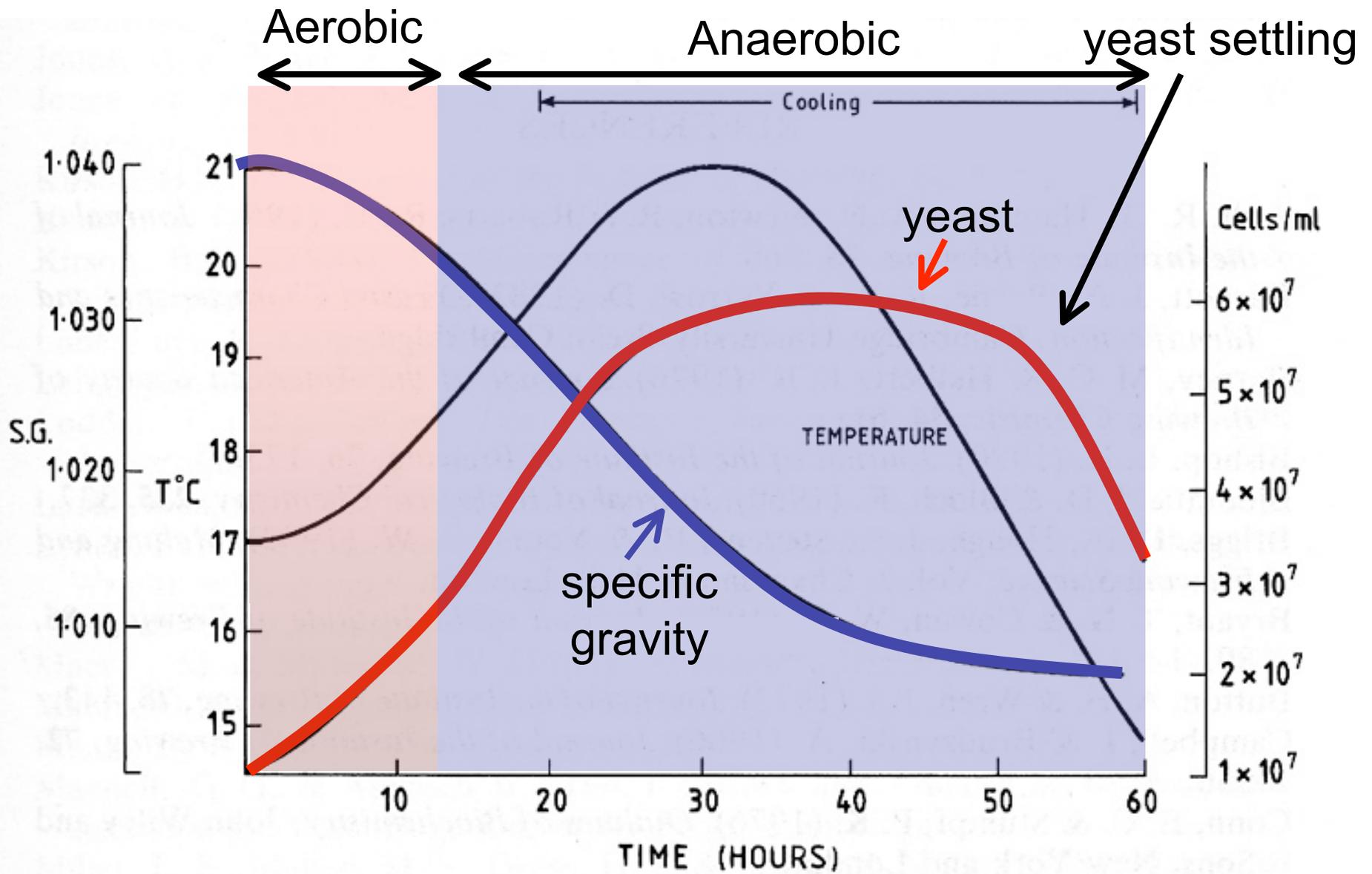
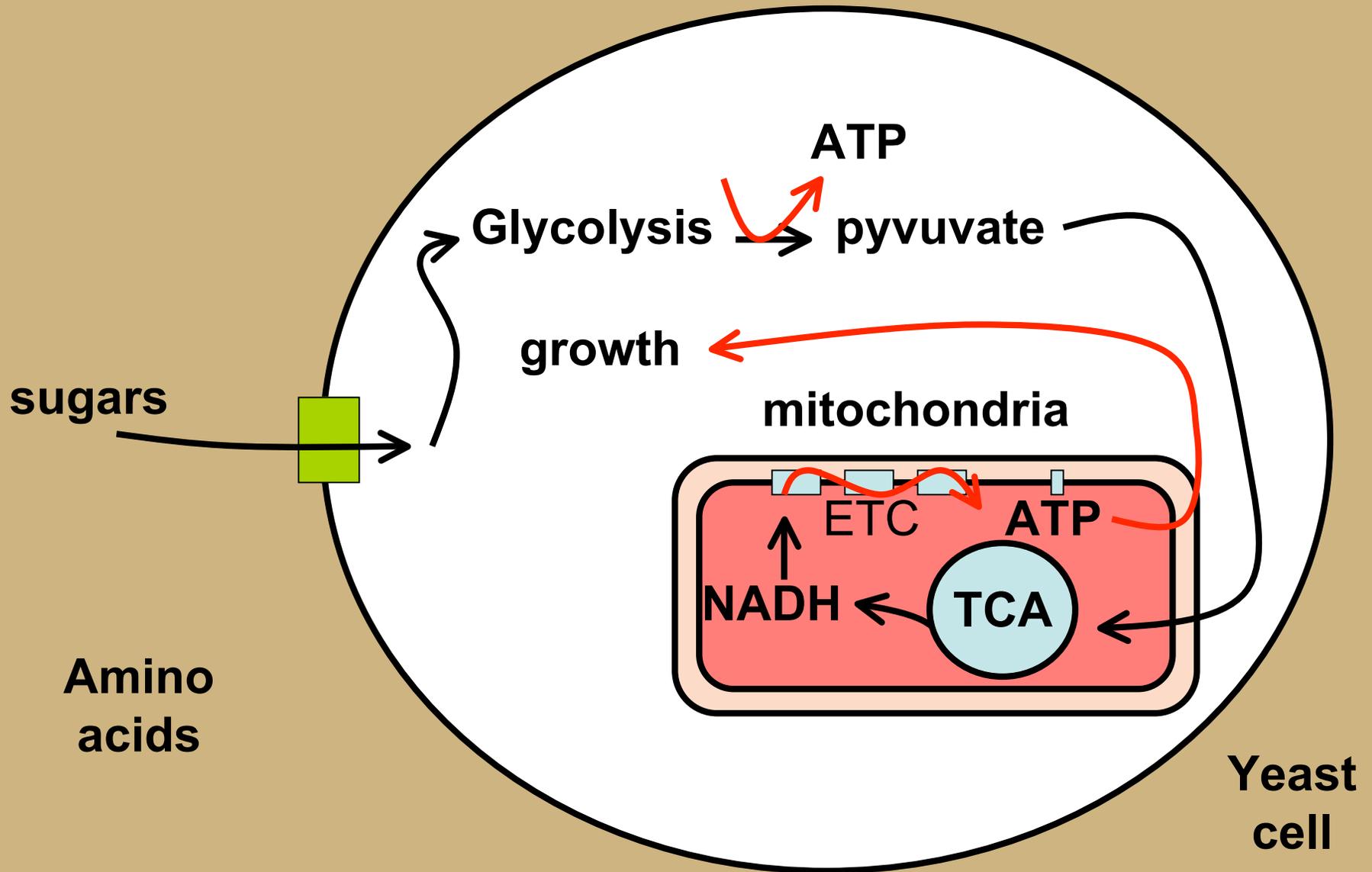


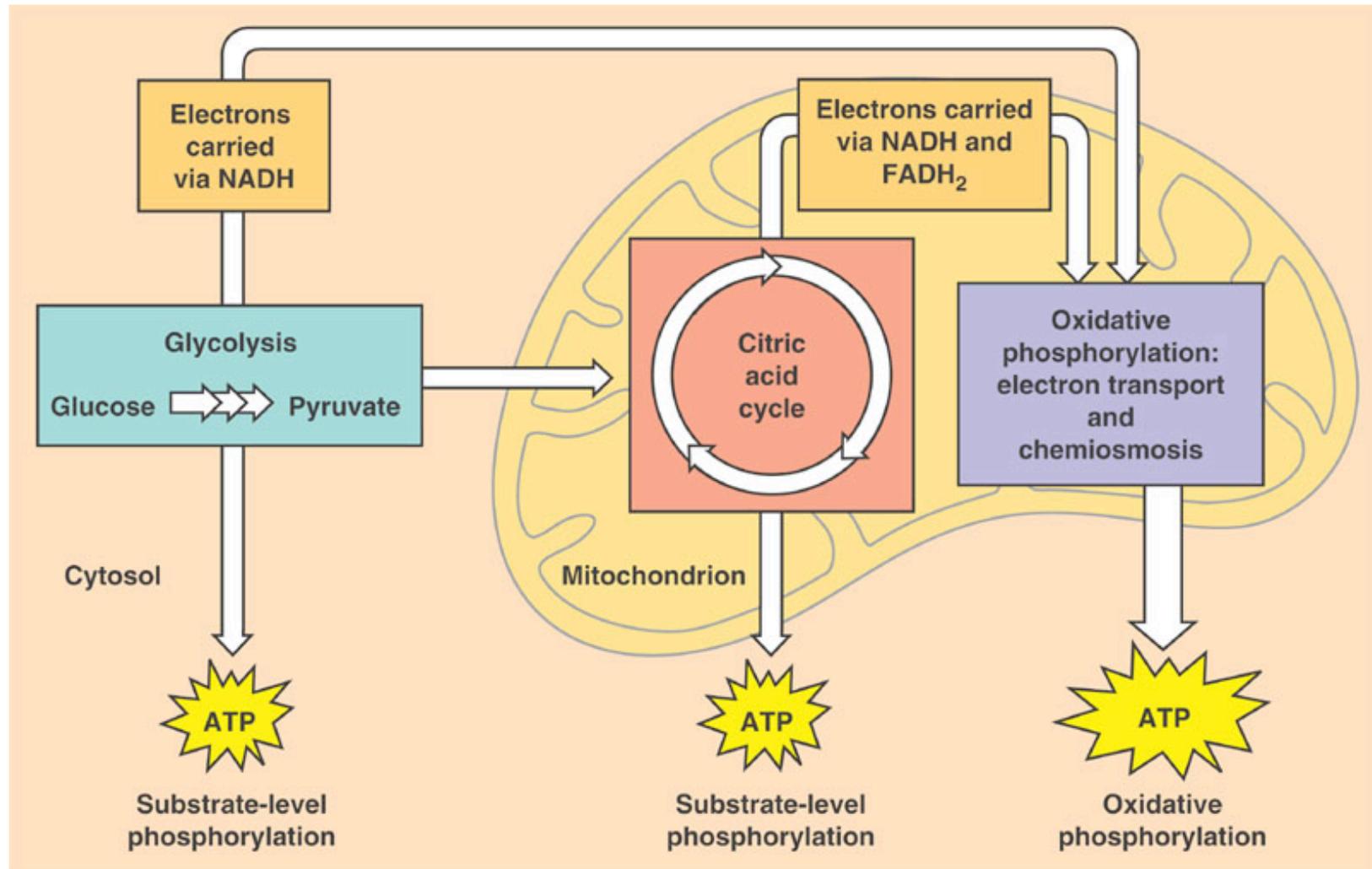
Fig. 8. Typical fermentation profile for modern batch fermentation to produce ale. SG, specific gravity; T, temperature.

Wort

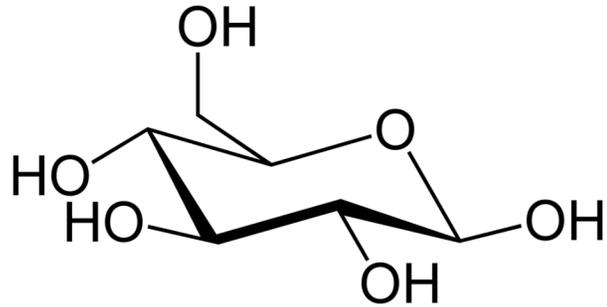
Respiration: in presence of oxygen



Aerobic Respiration: Overview

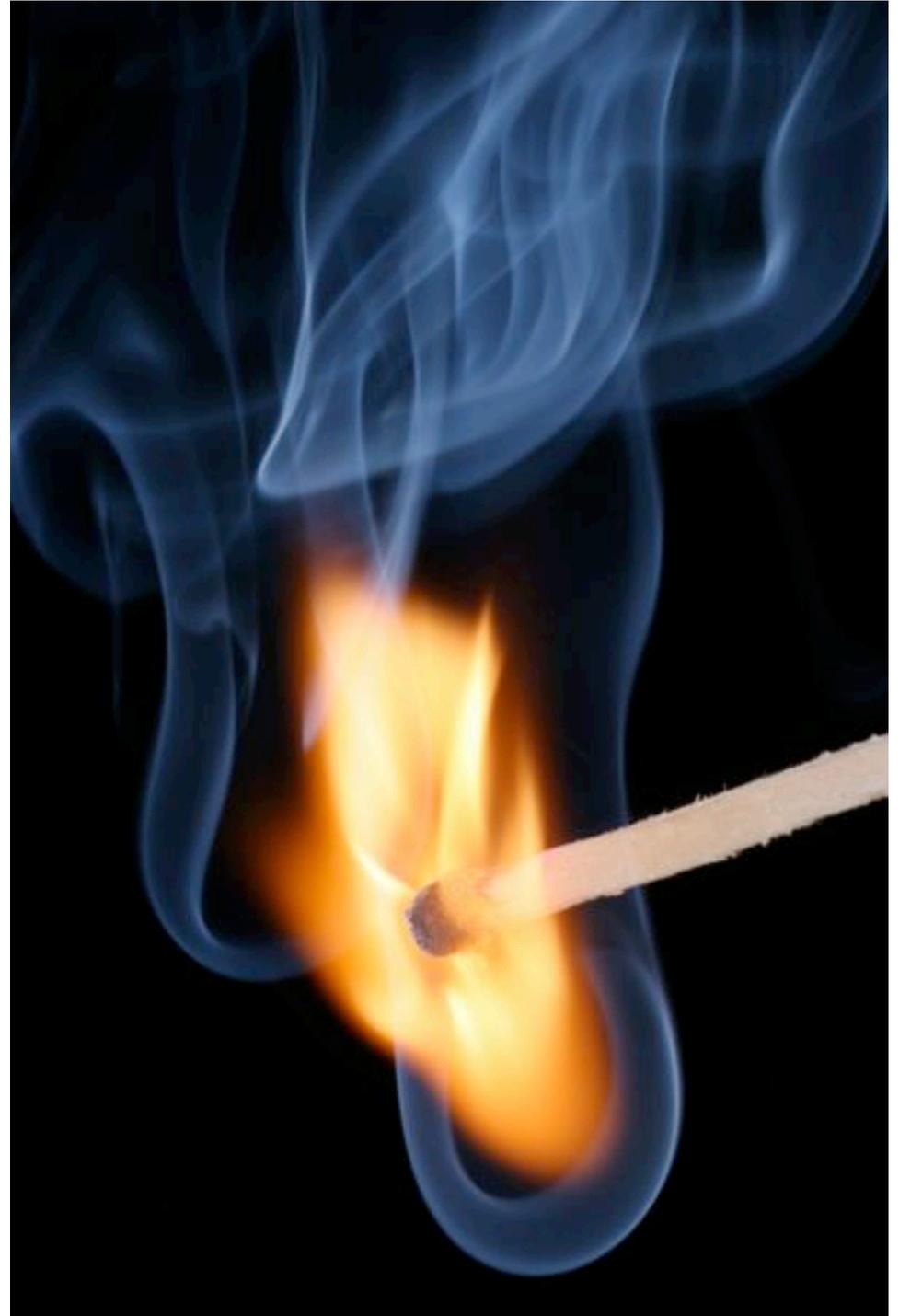


Energy from Glucose



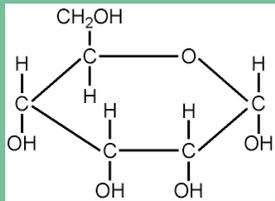
-686 kcal/mol
(-2870 kJ/mol)

Glycolysis and the Citric Acid Cycle break down glucose in a step wise fashion to gradually release the energy



Glycolysis: located in the cytoplasm

Benefit



2 NADH

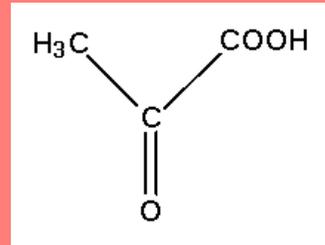
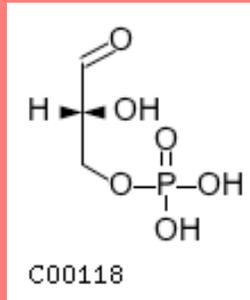
2 ATP

2 ATP



ATP

ATP

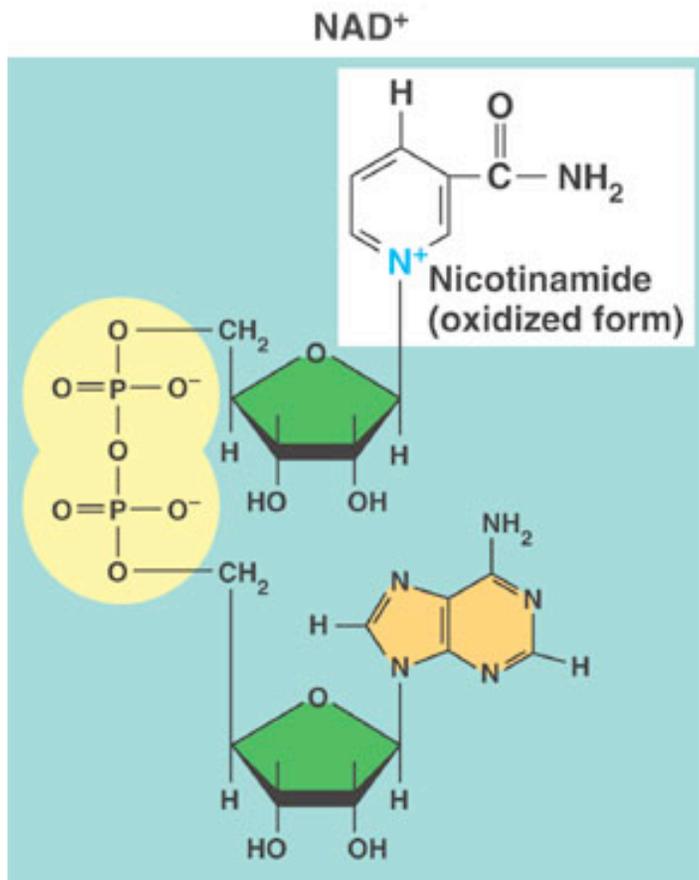


Cost

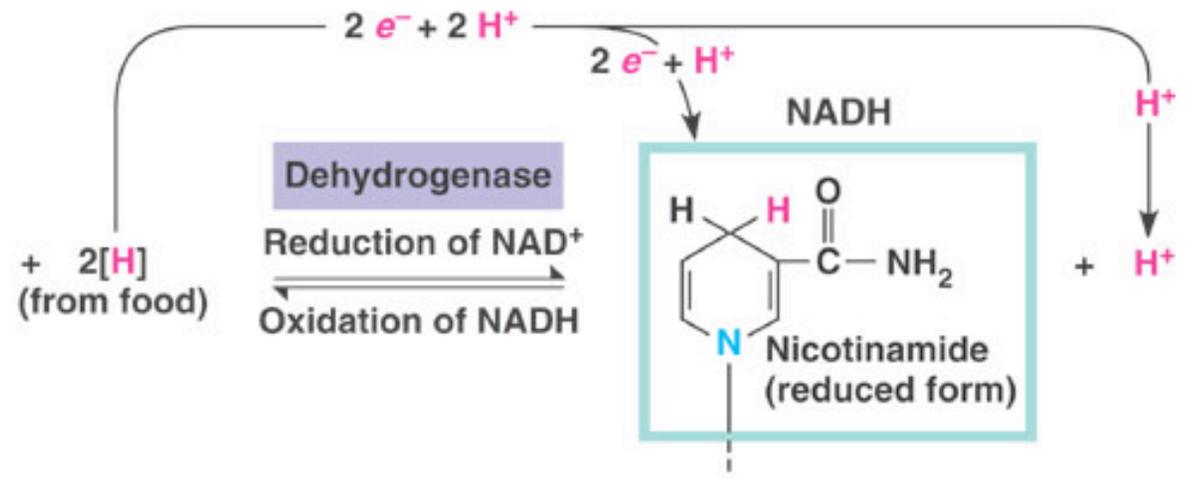
Net Benefit:
2 NADH
2 ATP

Nicotinamide Adenine Dinucleotide Functions as an **Electron Shuttle**

oxidized



reduced



Citric Acid Cycle (Tricarboxylic acid cycle)

Start with a 3 carbon compound (pyruvate)

Lose 3 carbons as CO_2 in oxidation reactions.

Electrons go to NADH

Pyruvate
(from glycolysis,
2 molecules per glucose)

NAD^+
 $\text{NADH} + \text{H}^+$

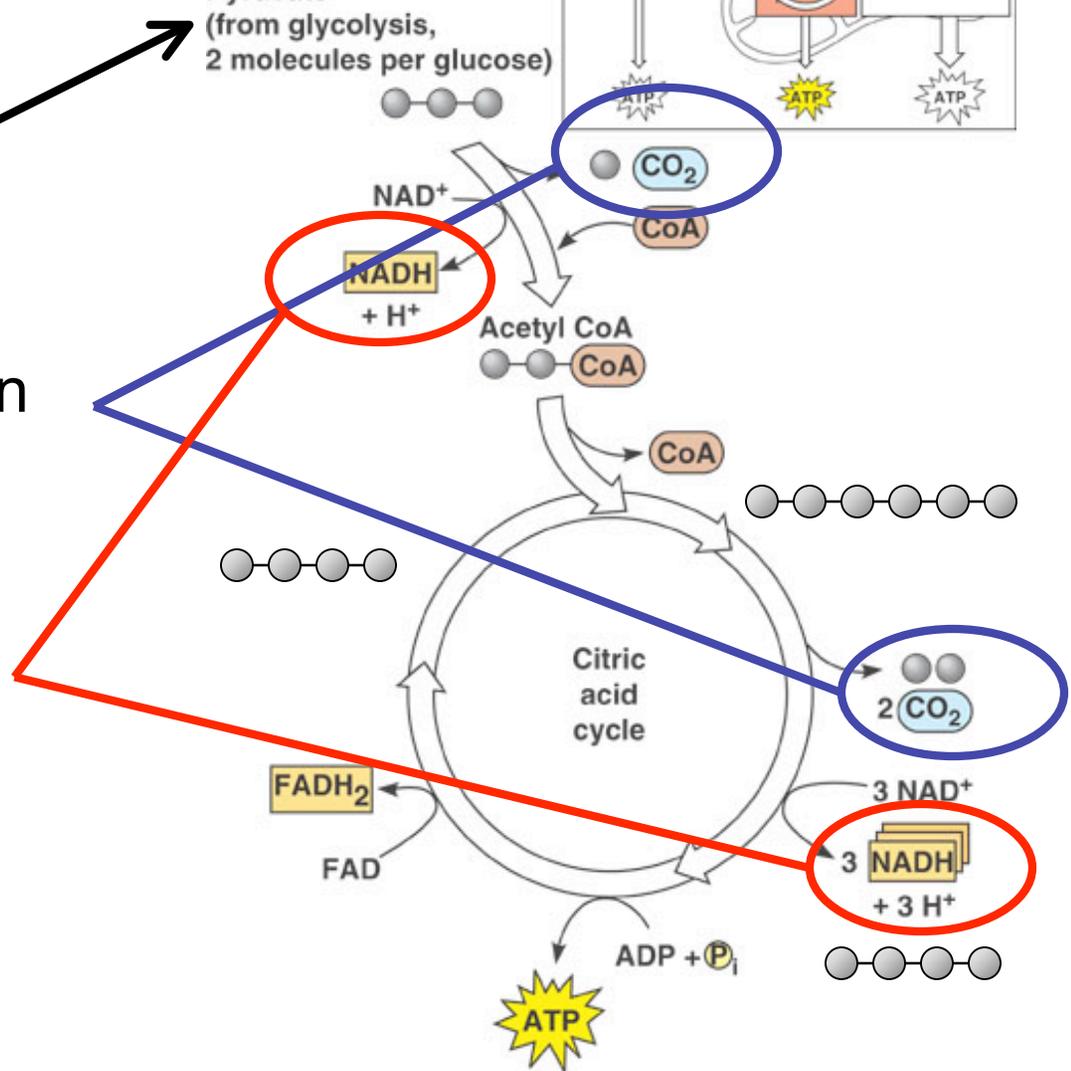
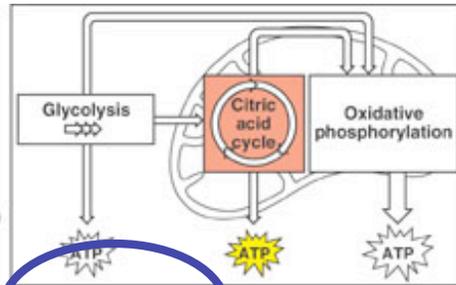
Acetyl CoA

2CO_2

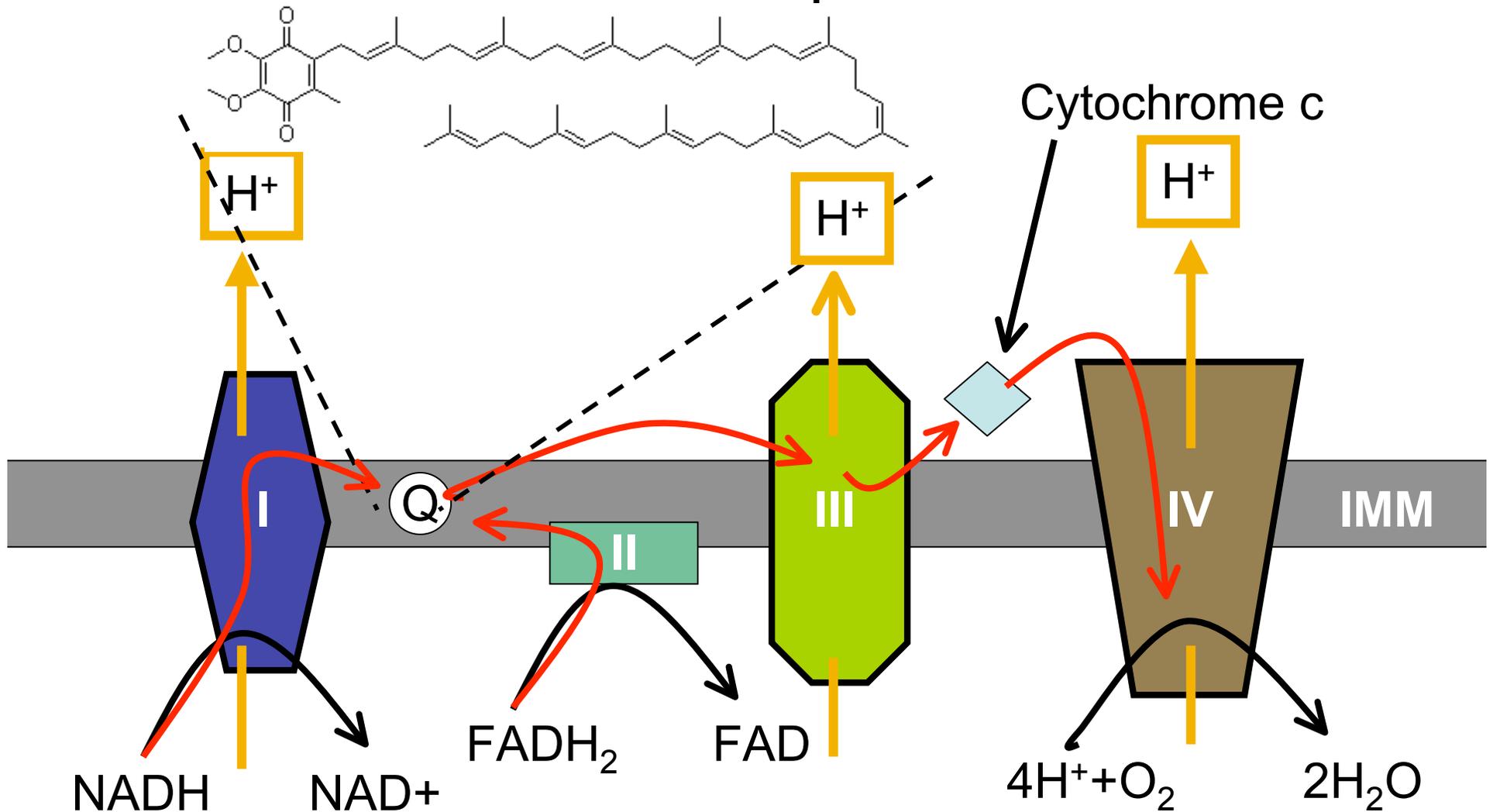
3NAD^+
 $3 \text{NADH} + 3 \text{H}^+$

$\text{ADP} + \text{P}_i$

ATP



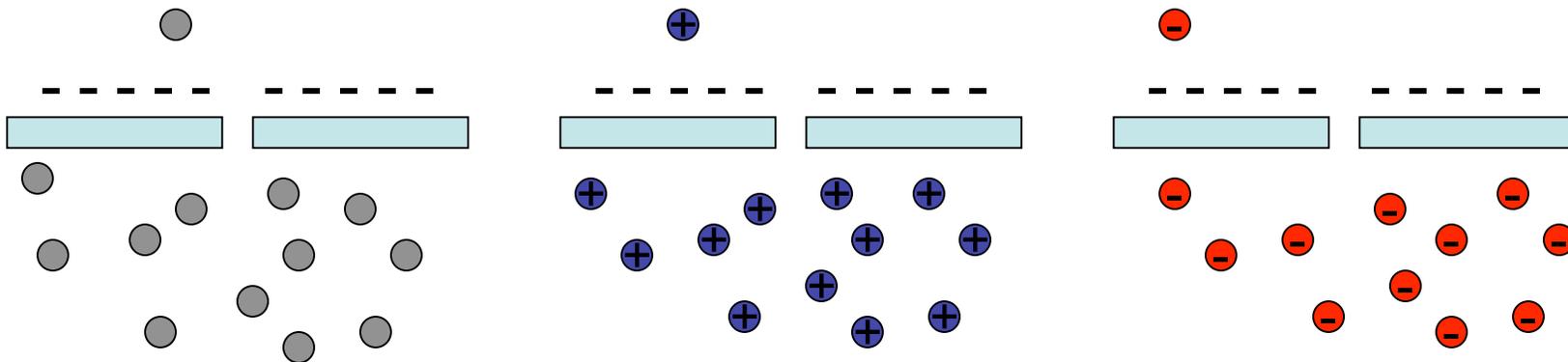
Electron Transport Chain



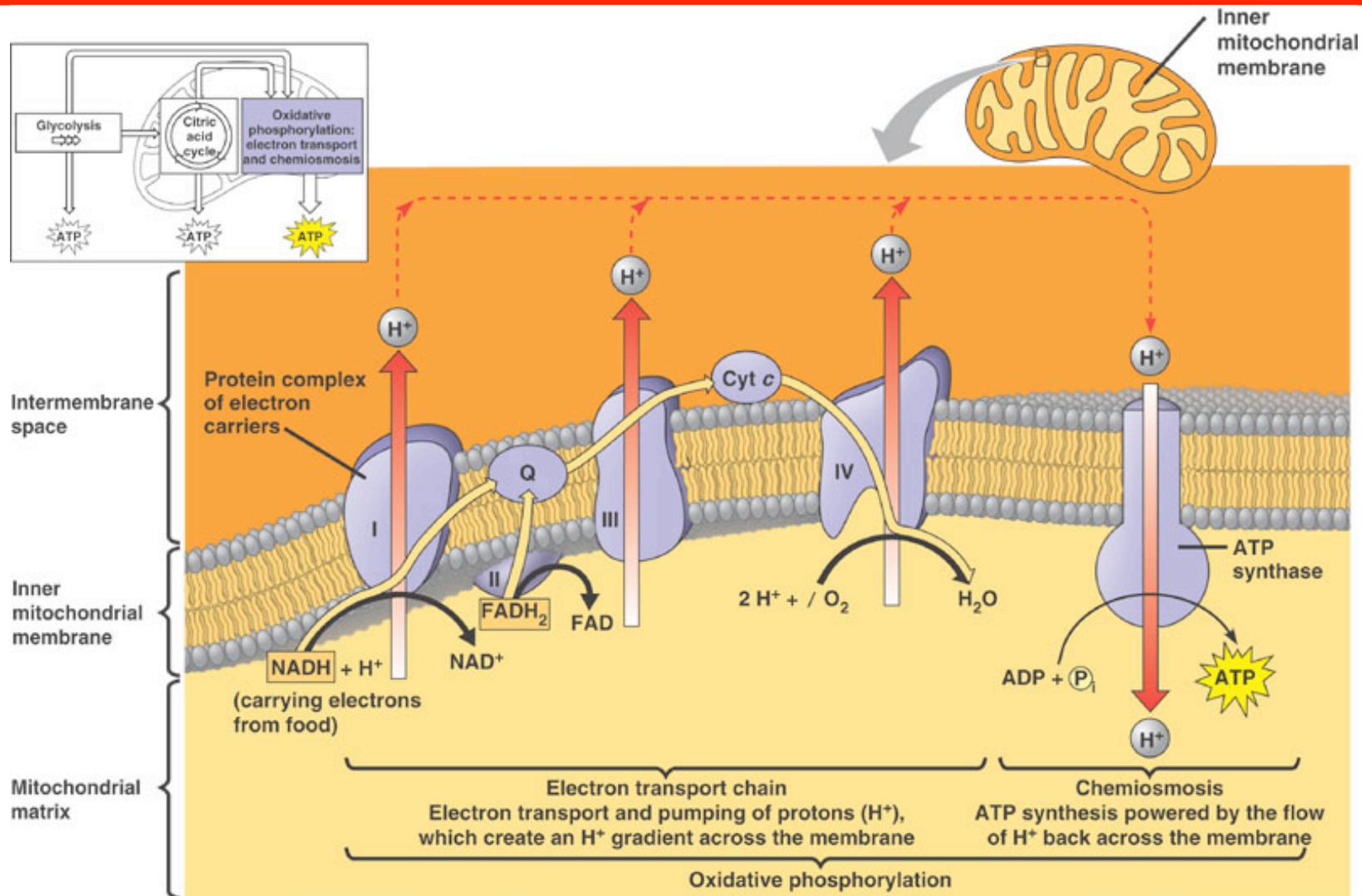
Mitochondrial Matrix

Cytochrome Oxidase

Electron transport generates a large **electro**-chemical gradient across the inner mitochondrial membrane

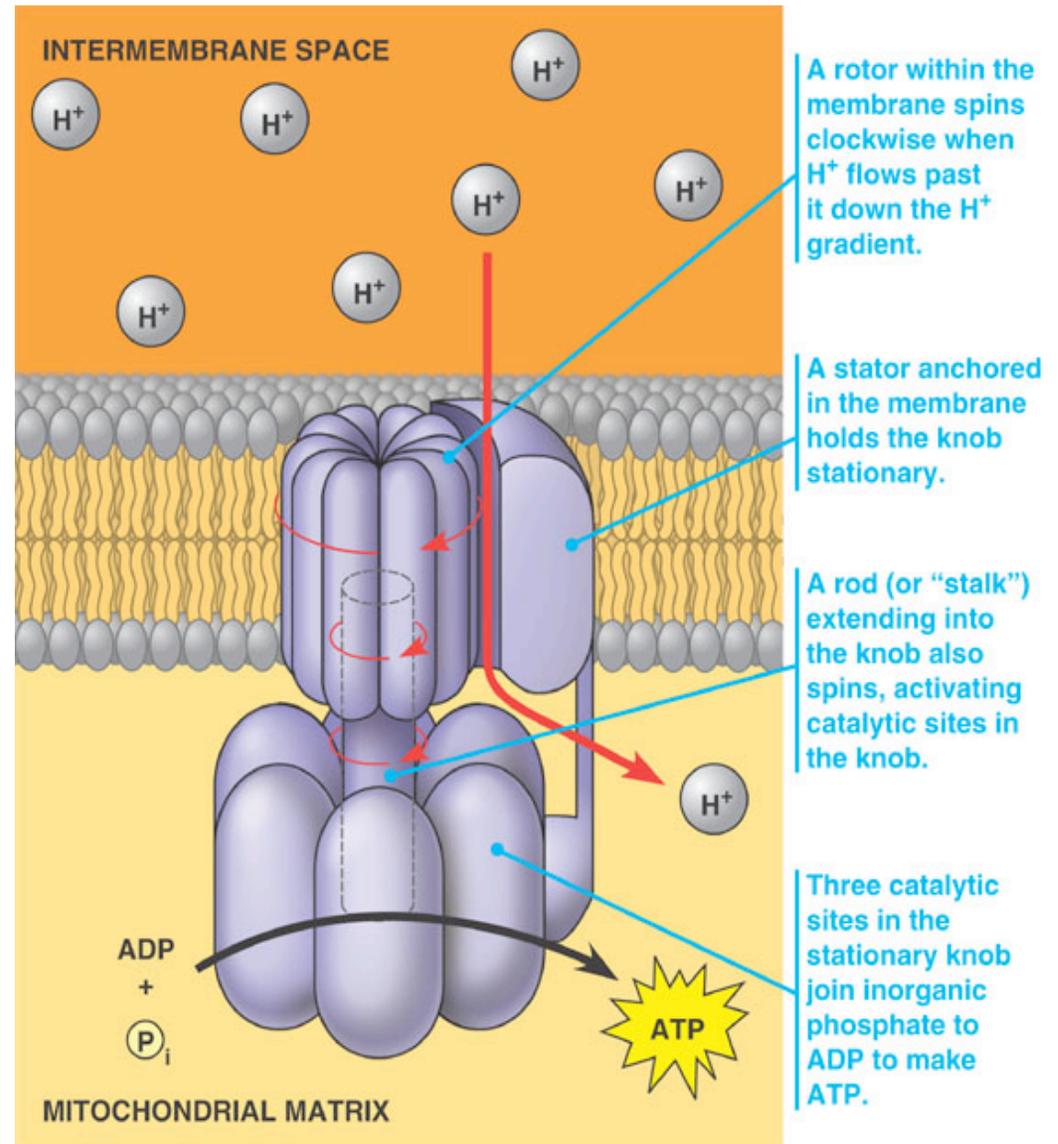


Electron transport generates a large electrochemical gradient across the inner mitochondrial membrane

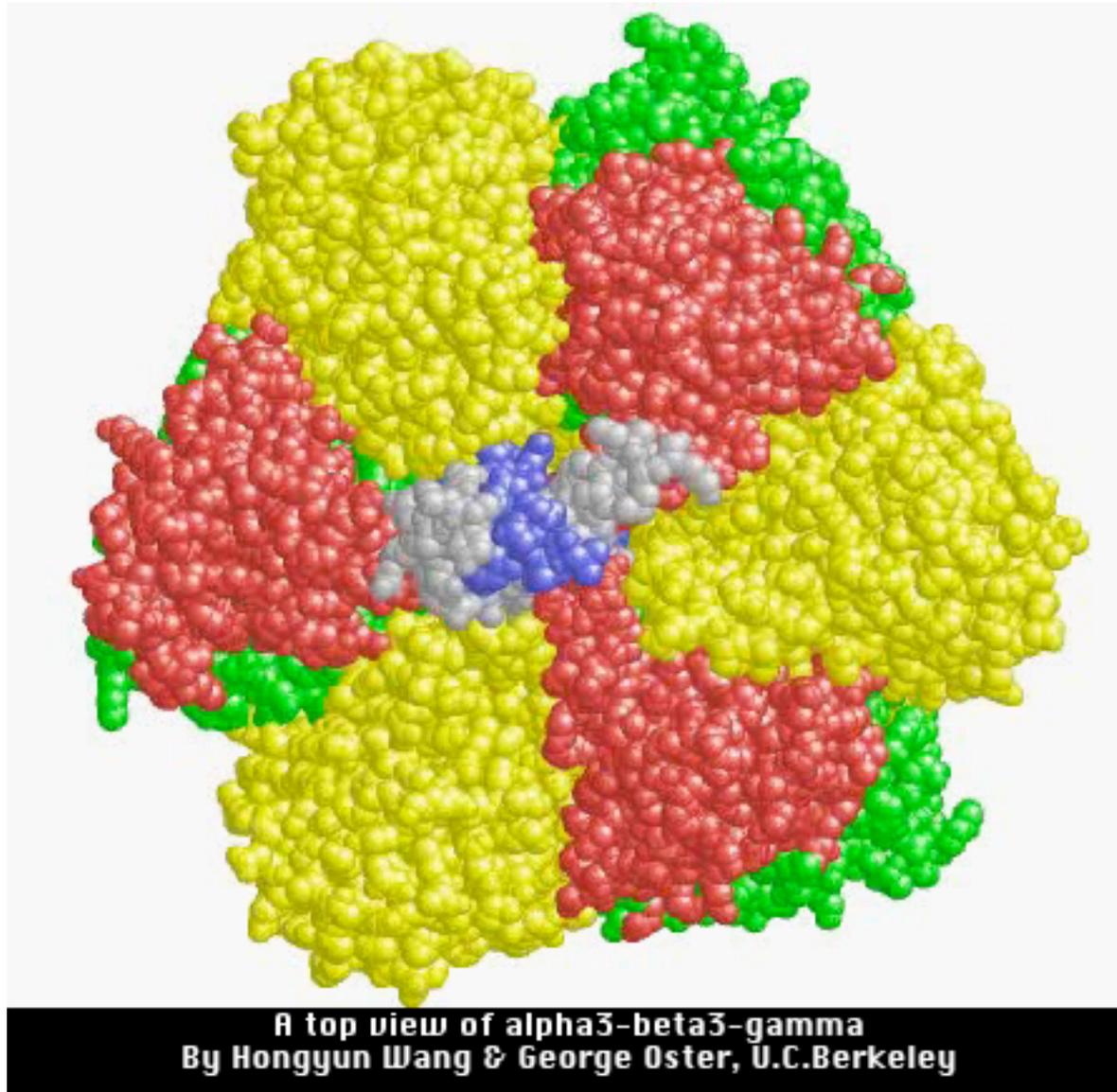


ATP synthase: chemiosmotic mechanism

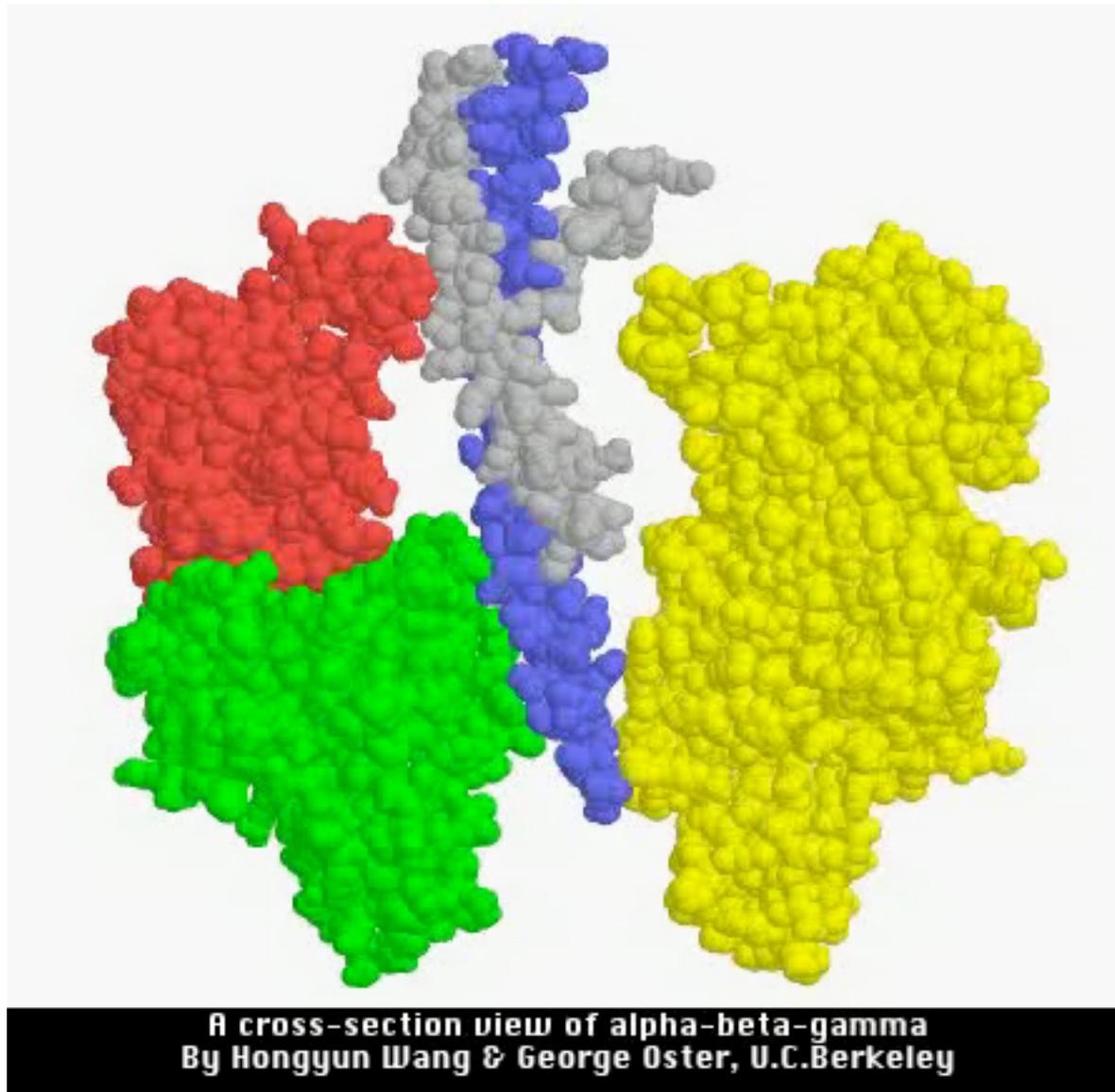
- Proton gradient used to do work like water turning a turbine to make electricity
- Movement of protons causes ATPase stalk to turn, driving the production of ATP



ATP synthase: chemiosmotic mechanism



ATP synthase: chemiosmotic mechanism



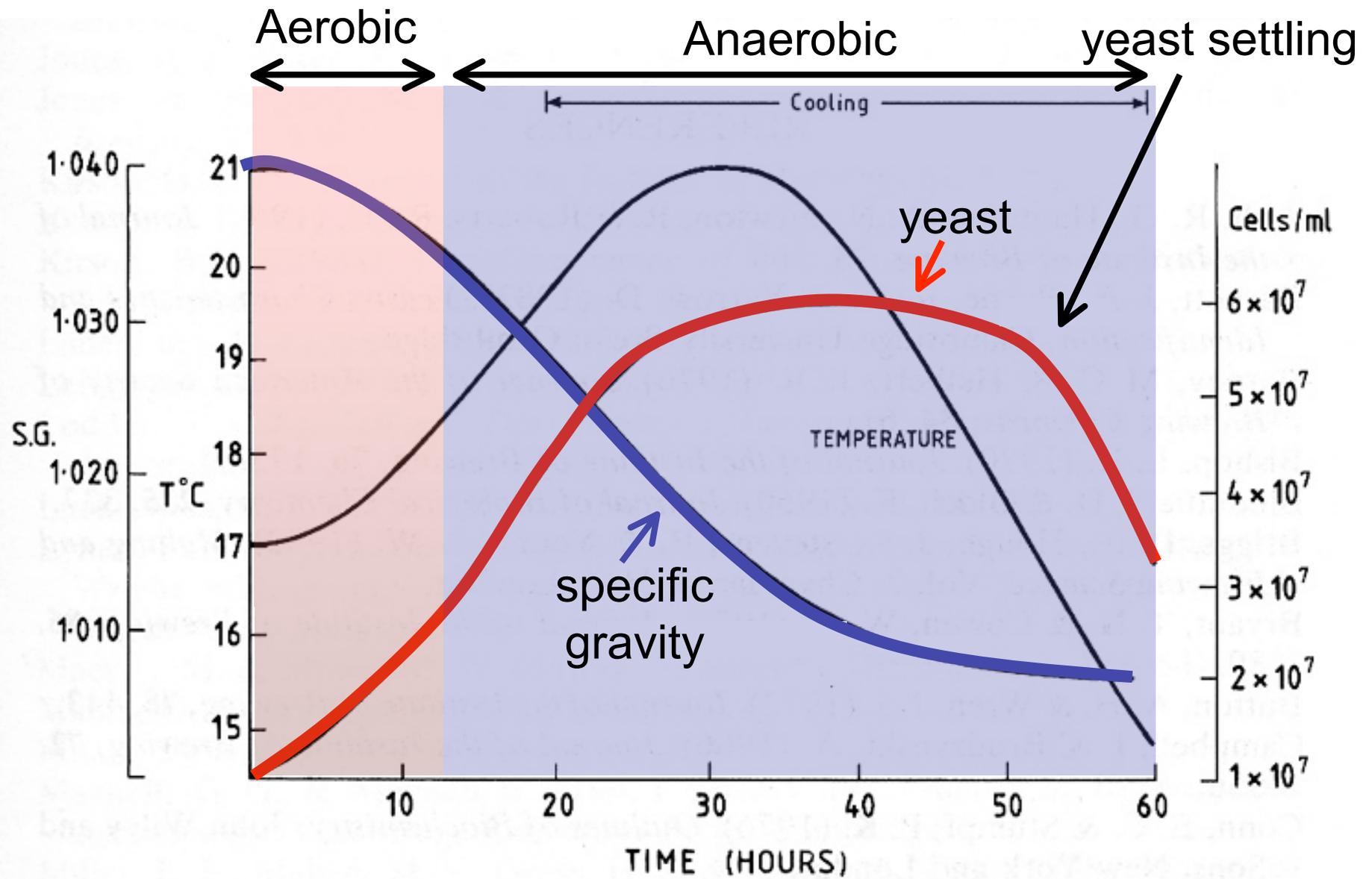
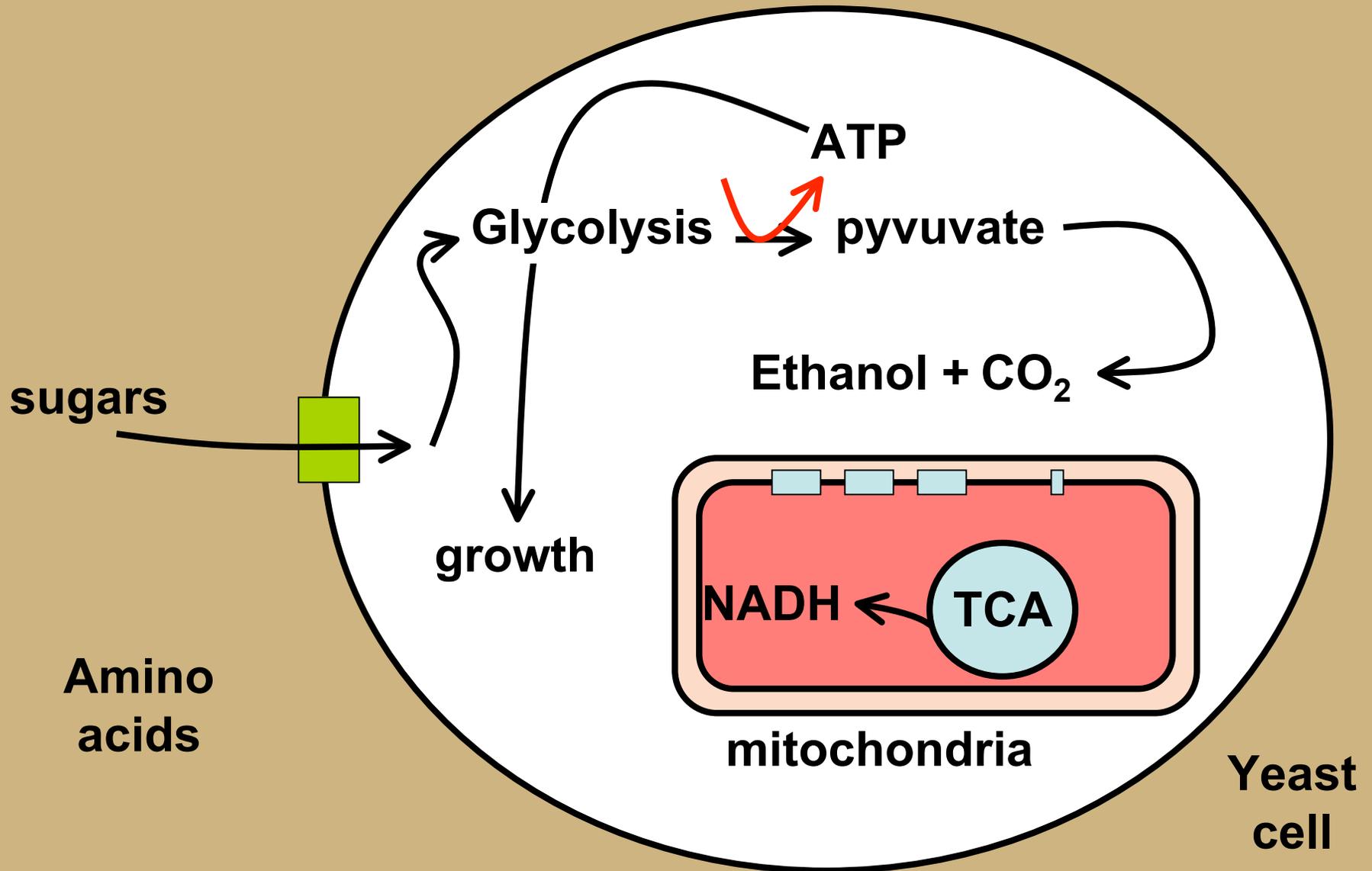


Fig. 8. Typical fermentation profile for modern batch fermentation to produce ale. SG, specific gravity; T, temperature.

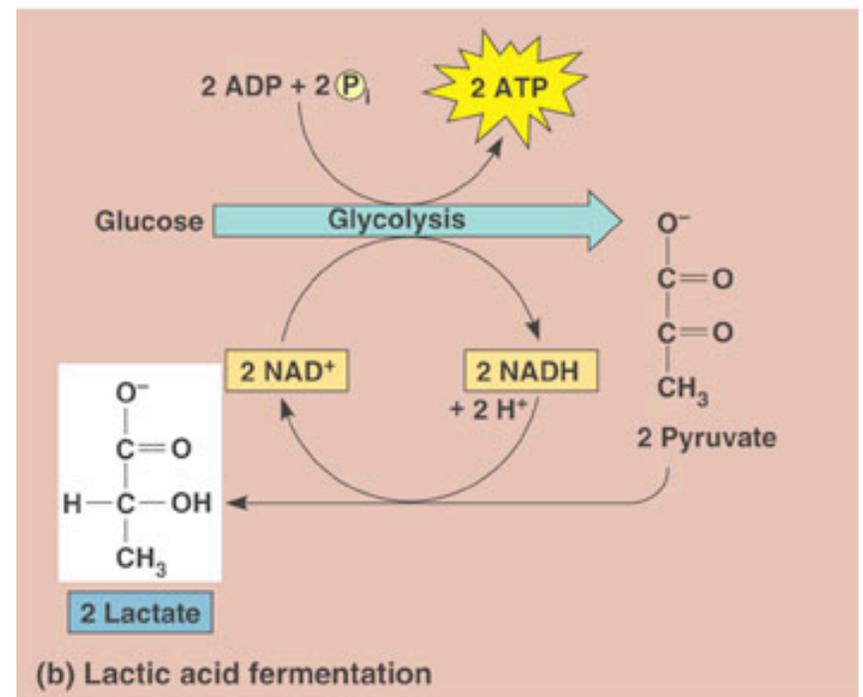
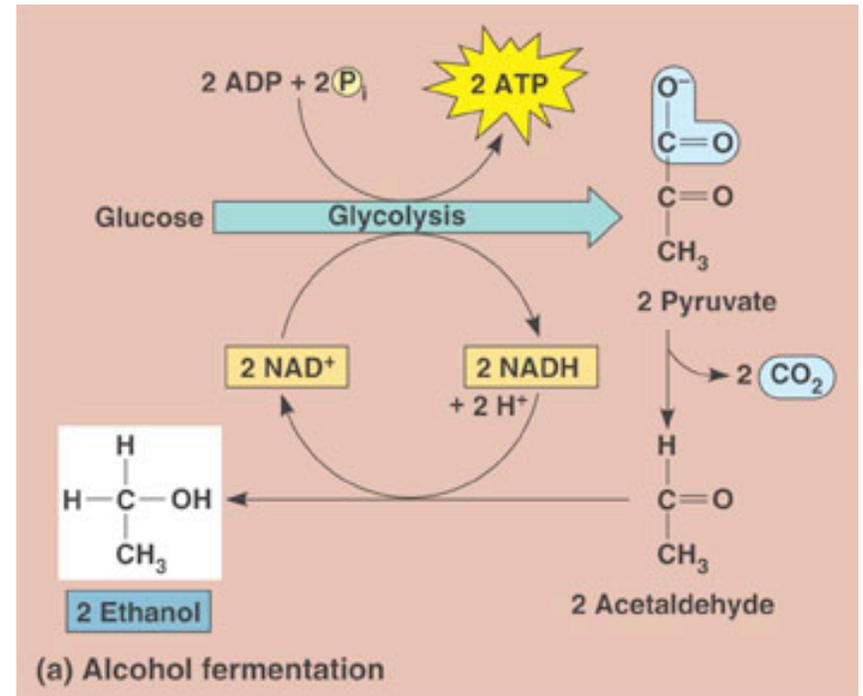
Wort

Fermentation: in absence of oxygen



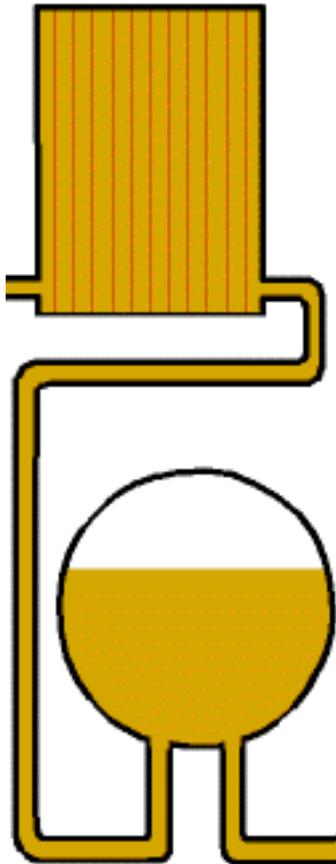
Fermentation:

- Production of ethanol (or Lactic acid) regenerates NAD^+ (oxidized) to allow glycolysis to continue!
- This occurs in the absence of O_2

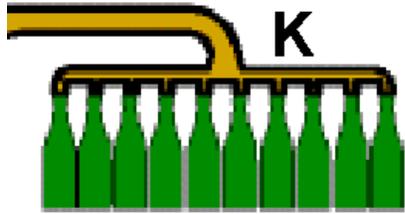


What happens to beer after fermentation?

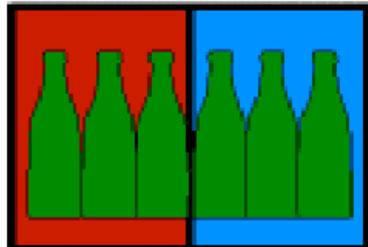
Maturation stage



Beer is chilled and stored, causing proteins to precipitate (clarifies) and the removal of various compounds that impart off-flavours.



Bottling and Carbonation



K) Home-brewers add a small amount of sugar to beer before bottling to allow the yeast to produce CO_2 . Breweries carbonate with tanks of CO_2 .



L) Drink Beer (responsibly, and only if you're 19+)