

**MSC BOTANY**

**III SEMESTER**

**PHYSIOLOGY: NITROGEN METABOLISM**

**TOPIC: ACTION OF NITROGENASE**

**ENZYME**

PREPARED BY:

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DEPT OF BOTANY,

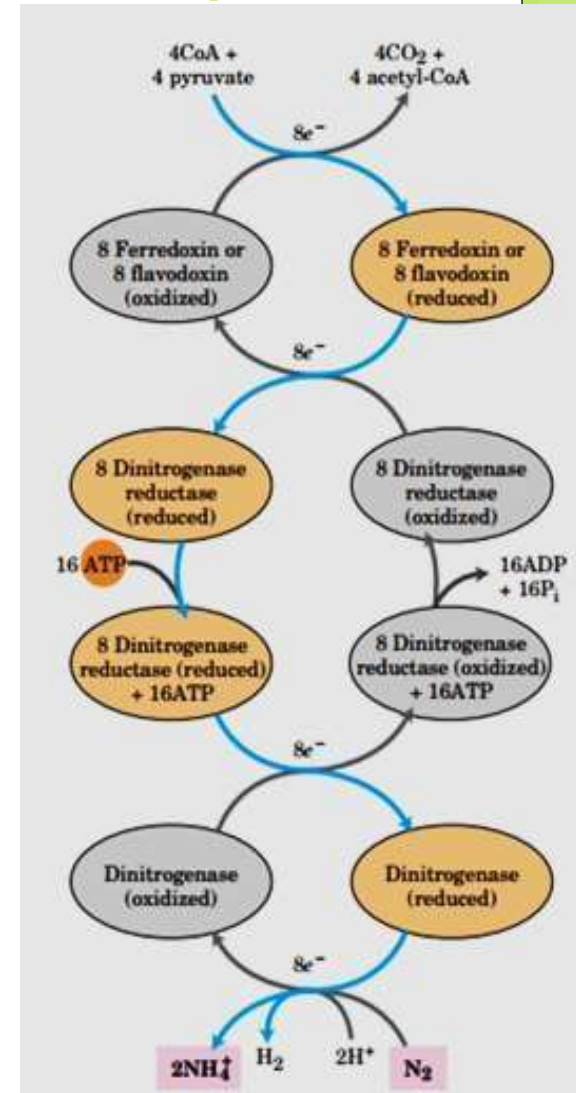
LF COLLEGE, GURUVAYOOR

# **ACTION OF NITROGENASE ENZYME**

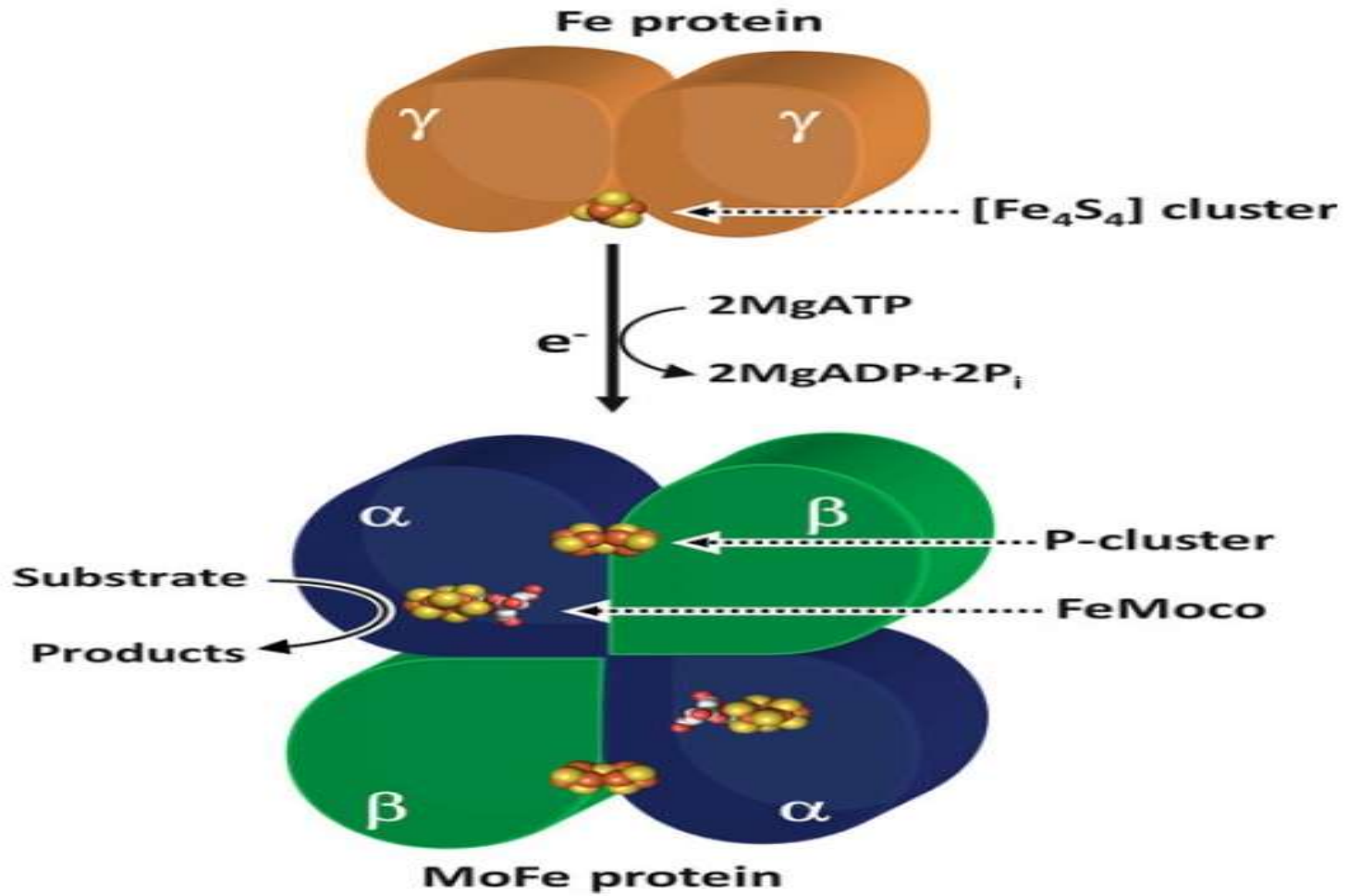
- ❑ For reducing nitrogen into ammonia nitrogenase requires 8 electrons
- ❑ The 8 electrons are transferred from reductase to dinitrogenase one at a time

# Action of nitrogenase enzyme

- Reduced reductase binds to dinitrogenase and transfers single electron, oxidized form dissociates in a repeating cycle
- Each cycle requires the hydrolysis of ATP molecule by dinitrogenase reductase



- ❑ Immediate source of electrons to reduce reductase is reduced ferredoxin**
- ❑ Ultimate source of electrons to reduce ferredoxin is pyruvate**



**The overall reaction for reduction of dinitrogen to ammonia by nitrogenase is as follows**



# Nitrogenase complex :

- **Biological nitrogen fixation is carried out by a highly conserved complex of proteins called as nitrogenase complex**
- **Which is mainly consists of 2 important proteins**
  - **Fe protein (dinitrogenase reductase)**
  - **Mo-Fe protein (dinitrogenase)**



- **Structure**
- **Dinitrogenase reductase – is a dimer of 2 identical subunits**
- **It contains a single 4Fe – 4S redox centre bound between the subunits**
- **This can be oxidized and reduced by 1 electron**
- **Also it has 2 binding sites for ATP or ADP**

- **Dinitrogenase – is a tetramer with 2 copies of 2 different subunits ( $\alpha_2 - \beta_2$  heterodimer)**
- **Contains both iron and molybdenum**

The reduction of dinitrogen is a two step process

- ❖ In the first step , the Fe protein of dinitrogenase reductase is reduced by the primary electron donor ,usually ferredoxin
- ❖ Ferredoxin is a small protein containing iron sulphur

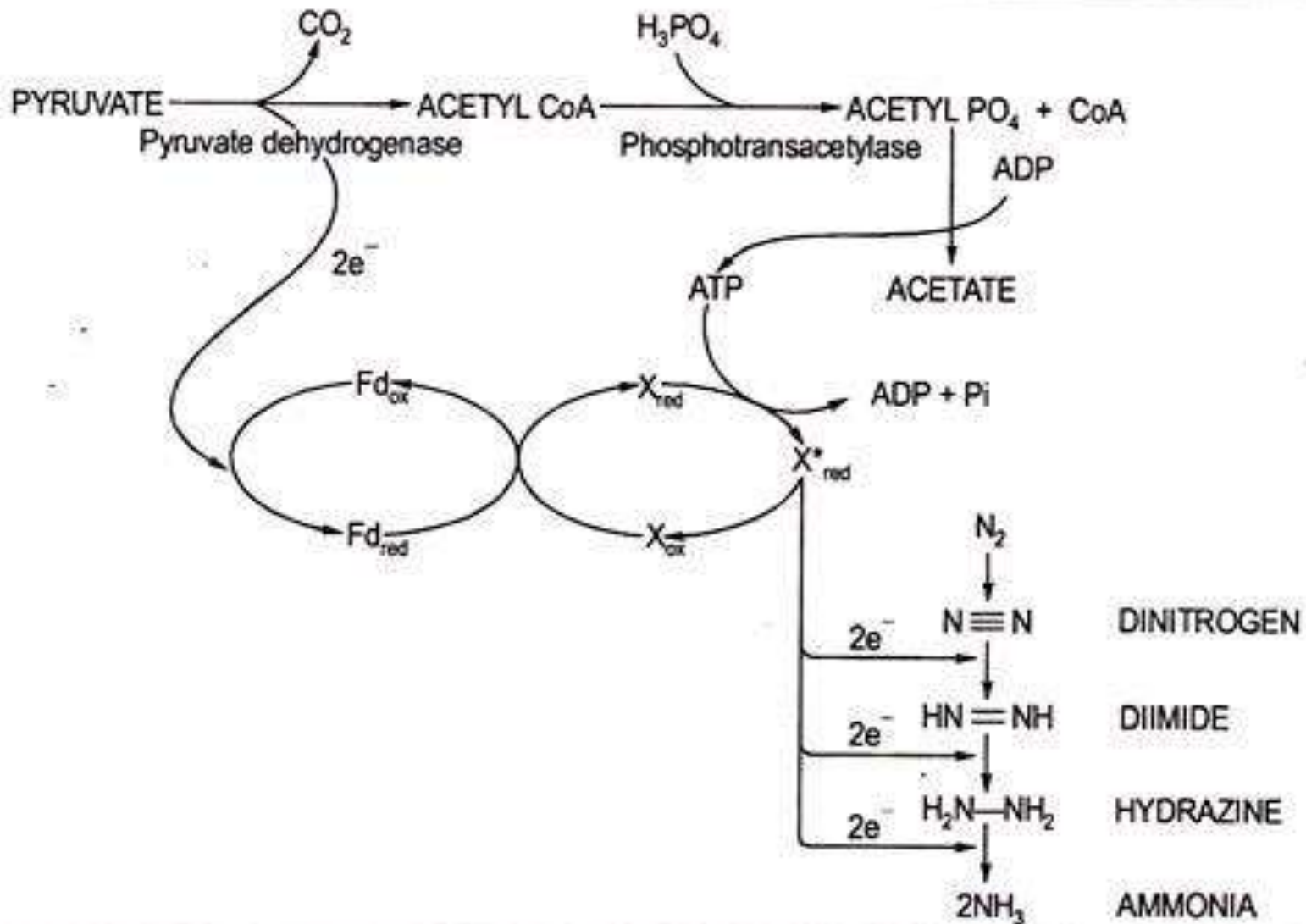
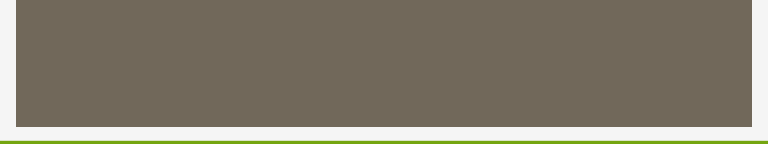


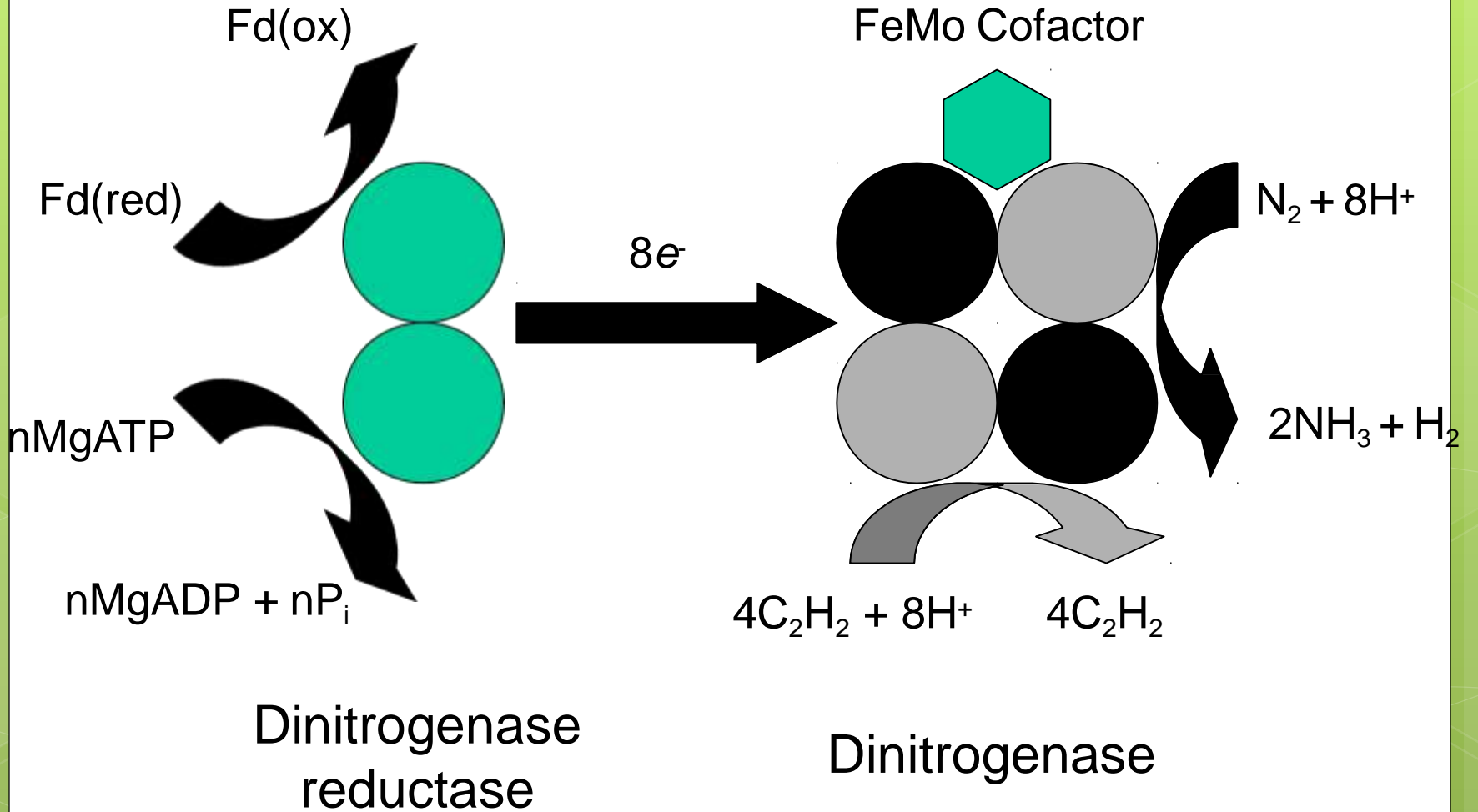
Fig. 10.6 : Reduction of nitrogen to ammonia by the enzyme system of *C. pasteurianum*. X = Nitrogenase

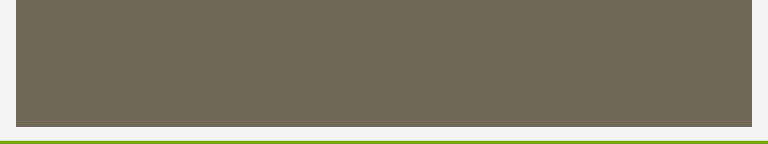


❖ In the second step , the reduced Fe protein passes electrons to the MoFe protein (dinitrogenase) which catalyses the reaction

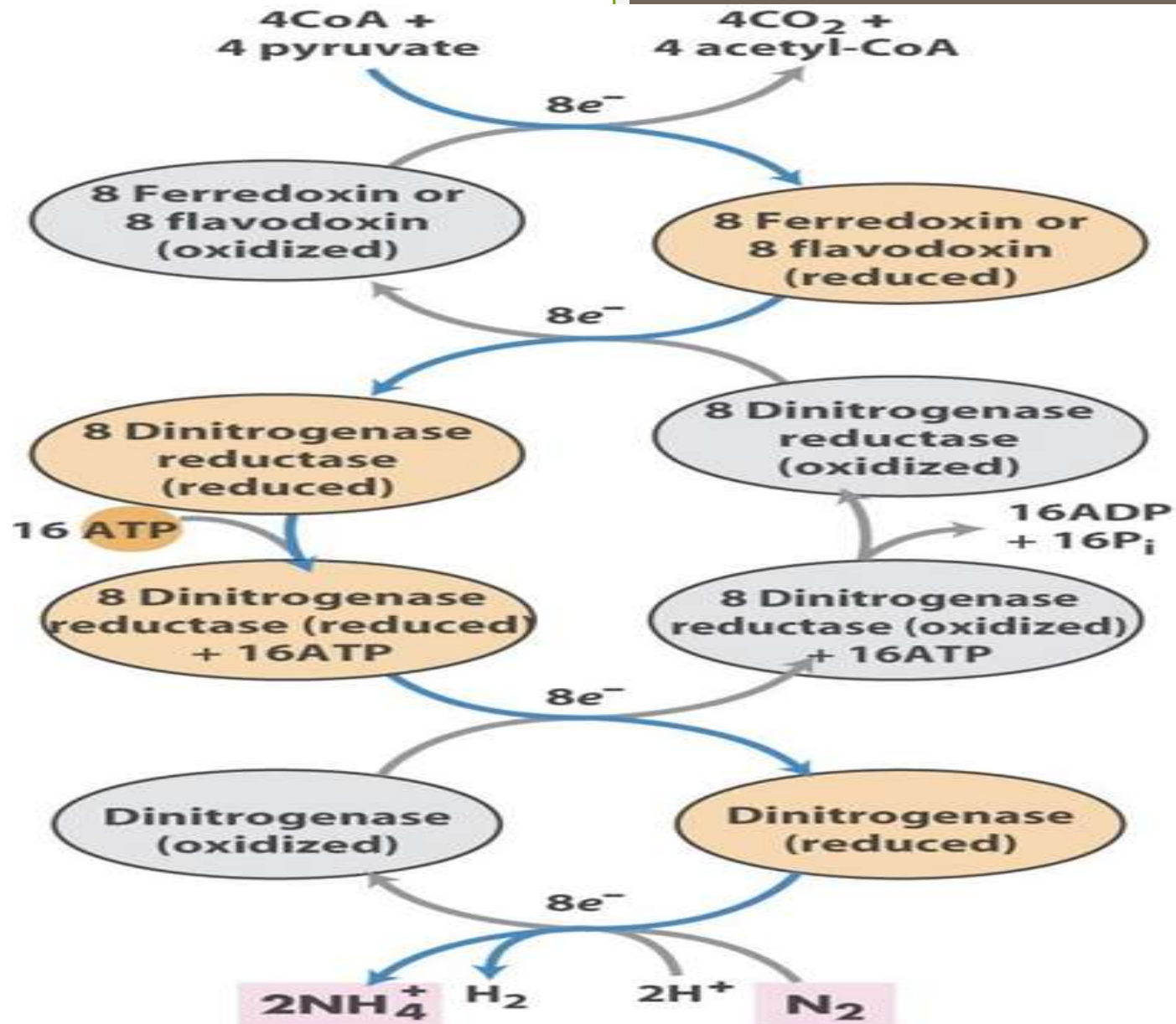
❖ The role of ATP in this process is interesting , it appears to be catalytic rather than thermodynamic

# Nitrogenase





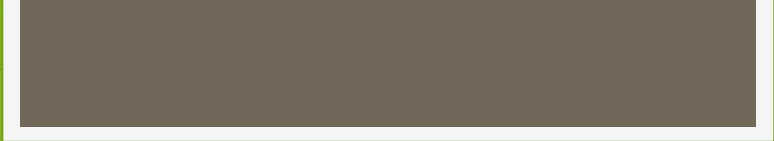
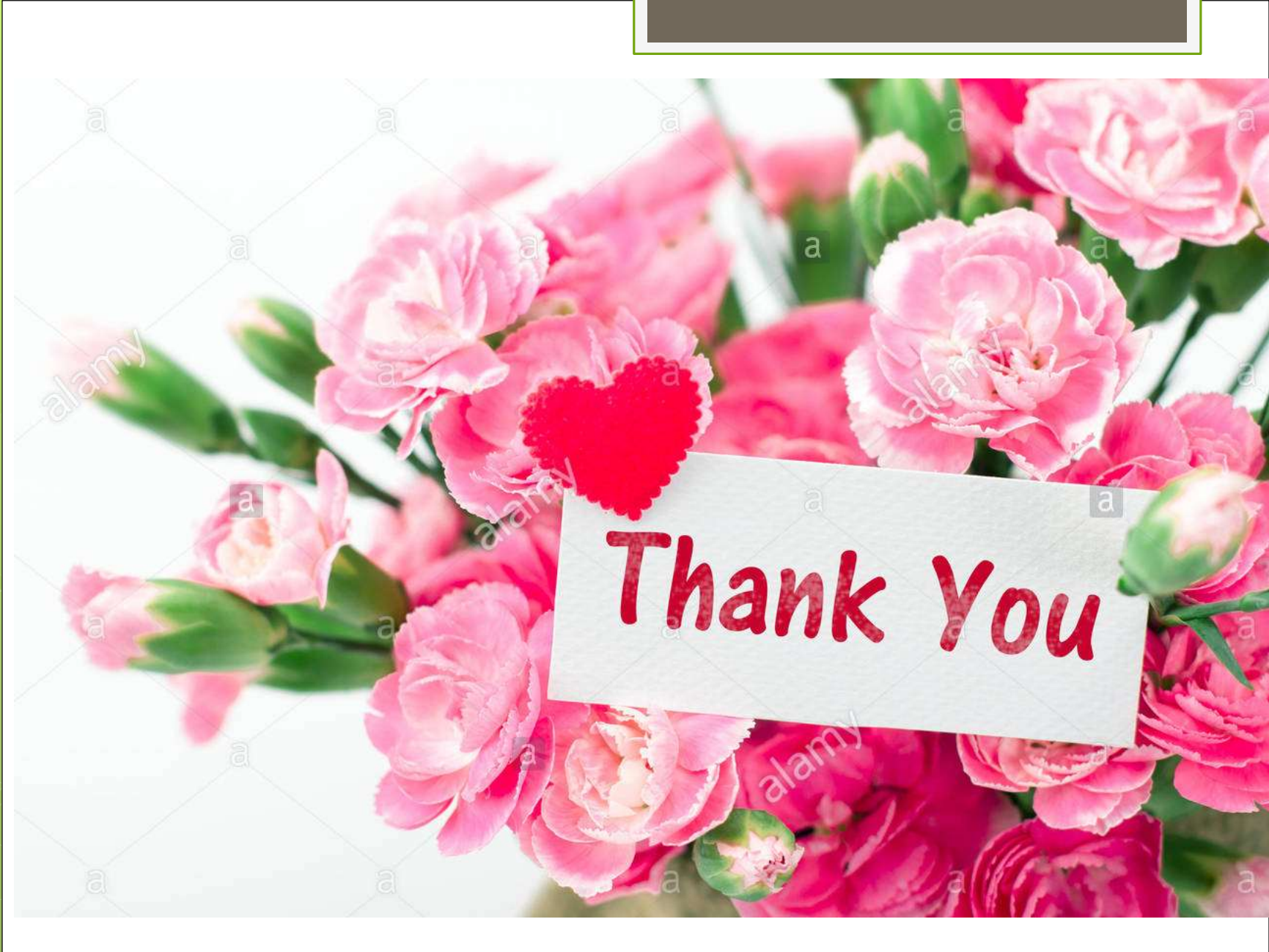
In the reaction carried out by dinitrogenase reductase, both ATP binding and ATP hydrolysis brings about conformational change that helps to overcome the activation energy of nitrogen fixation





## **Source of reducing power**

**The reducing power is supplied to nitrogenase in the form of reduced ferredoxin or flavodoxin**



**Thank You**