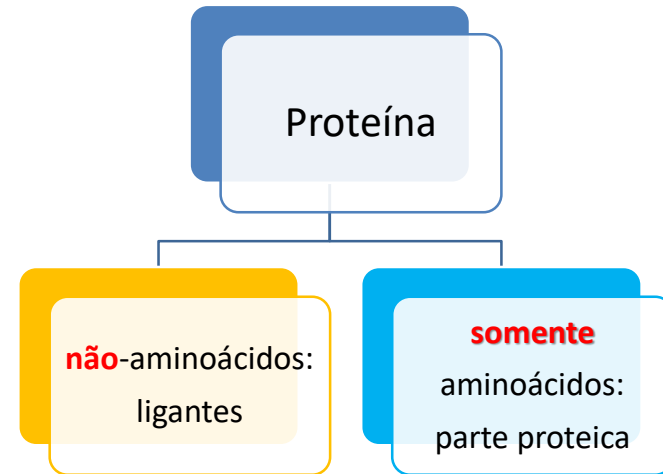


Ligantes

Ignez Caracelli



Julio Zukerman Schpector





Ligantes ocasionais

não aparecem sempre com a mesma proteína

exemplo:

toxina de escorpião

1SN1 (sem ligantes)

1SN4 (com ligante – íon acetato)

Ligantes necessários

aparecem **sempre** com a mesma proteína

exemplo:

ciclooxigenase-2 – grupo heme

exemplo:

anidrase carbônica – íon metálico Zn^{2+}

exemplo:

lectina – açúcares (manose, lactose, galactose,..)

PDB
sum

<http://www.ebi.ac.uk/pdbsum/>

Go to PDB code

go



Ligantes e Proteínas

grupo heme

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Description

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[PROCHECK](#)

Protein chains

[A](#) [C](#) [E](#) [G](#) 141 a.a.

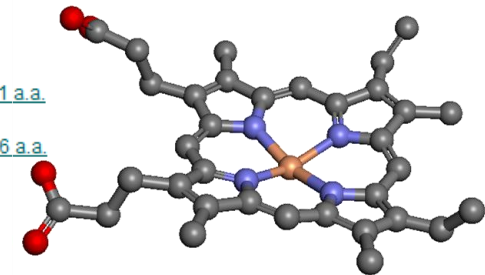
[B](#) [D](#) [F](#) [H](#) 146 a.a.

Ligands

[HEM](#) ×8

[Waters](#) ×573

parte integrante da proteína: **cofator**





Ligantes e Proteínas

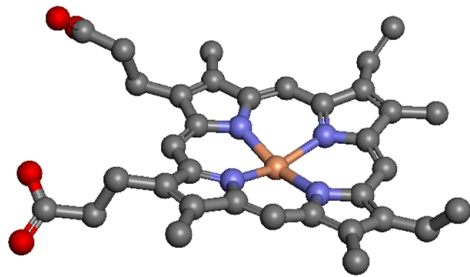
grupo heme

Proteínas com grupo heme:

- Mioglobina
- Hemoglobina
- Citocromo
- Ciclooxigenase
- IDO
- TDO
- iNOS, eNOs, nNOS
- Catalase
- etc.



2hbs

parte integrante da proteína:
cofator



Ligantes e Proteínas

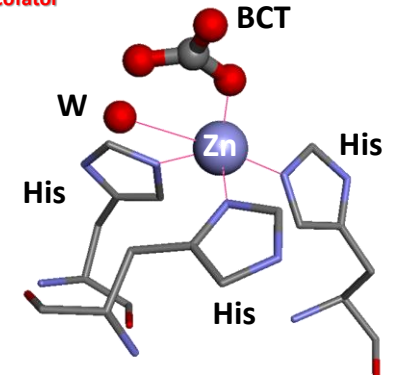
íons metálicos

Go to PDB code:  

Contents	
Description	
Header details	
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References	
PROCHECK	
Protein chain	258 a.a. *
Ligands	BCT
Metal ions	ZN
Waters	×254

anidrase carbônica: Zn



parte integrante da proteína:
cofator





Ligantes e Proteínas

compostos nucleotídeos

 Go to PDB code:  

Contents

Description

- [Header details](#)
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- [PROCHECK](#)

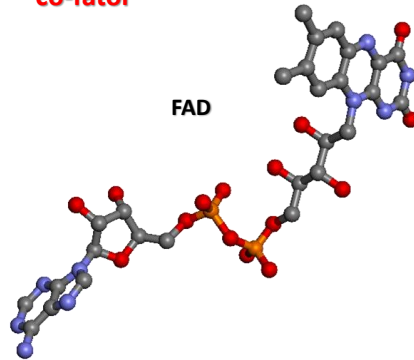
Protein chain

461 a a *

Ligands



- [FAD](#)
- [HXP](#)
- Waters ×517

parte integrante da proteína:
co-fator




Ligantes e Proteínas

compostos nucleotídeos

 Go to PDB code:  

Contents

Description

- [Header details](#)
- [Header records](#)
- [References](#)
- [PROCHECK](#)

Protein chain

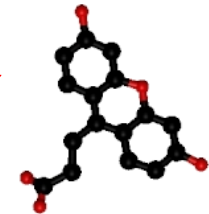
461 a a *

Ligands

- [FAD](#)
- [HXP](#)
- Waters ×517

inibidor (não é parte
integrante da proteína)



HXP





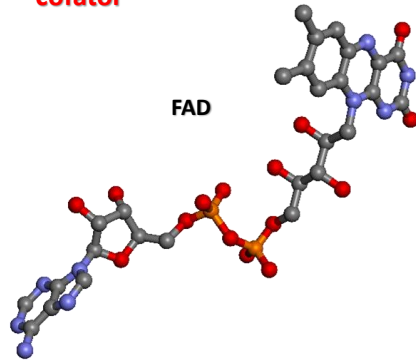
Ligantes e Proteínas

compostos nucleotídeos

Go to PDB code:  



Contents	
Description	Header details
	Header records
	References
	PROCHECK
Protein chain	461 a.a. *
Ligands	
	FAD
	NDP
	GSH-GSH
	Waters ×530

parte integrante da proteína
cofator



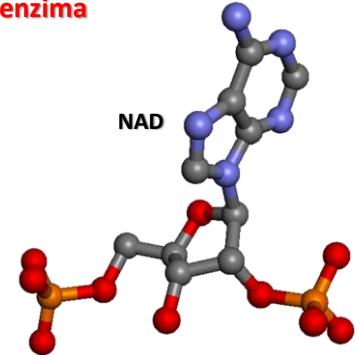
Ligantes e Proteínas

compostos nucleotídeos

Go to PDB code:  

Contents	
Description	Header details
	Header records
	References
	PROCHECK
Protein chain	461 a.a. *
Ligands	
	FAD
	NDP
	GSH-GSH
	Waters ×530

parte integrante da proteína
co-enzima



PDB
sumLigantes e Proteínas

Go to PDB code:

1gra

go



substrato

Contents

Description

Header details

Header records

References

PROCHECK

Protein chain

461 a.a.*

Ligands

FAD

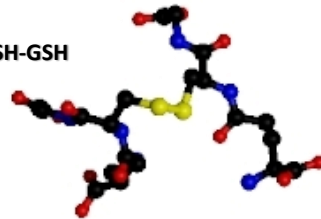
NDP

GSH-GSH

Waters ×530

ligante natural da proteína
(enzima): **substrato**

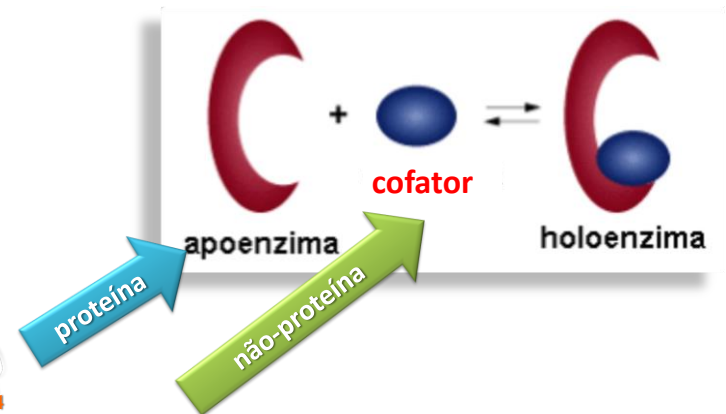
GSH-GSH



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Cofatores

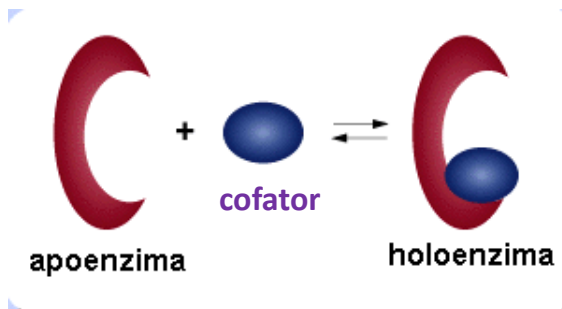
Cofator é um composto químico, a parte não-proteica ligada a uma enzima e necessária para a catálise



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Cofatores

- Cofator + enzima = Holoenzima
 - catalicamente ativo
- Holoenzima – Cofator = Apoenzima
 - catalicamente inativo



Cofatores

Necessidades de cofatores (molécula não-proteíca) atuando no processo:

- **Grupos prostéticos:**
 - associados a enzimas covalentemente (exemplo: grupo heme na ciclooxigenase, catalase, ...)
- Cofatores podem ser íons **metálicos:**
 - Cu^{2+} , Fe^{3+} , Zn^{2+}
 - (exemplo: grupo Fe^{3+} na Hemoglobina, Mioglobina, Citocromo, anidrase carbônica)

Cofatores

Podem ser moléculas orgânicas
ou
inorgânicas

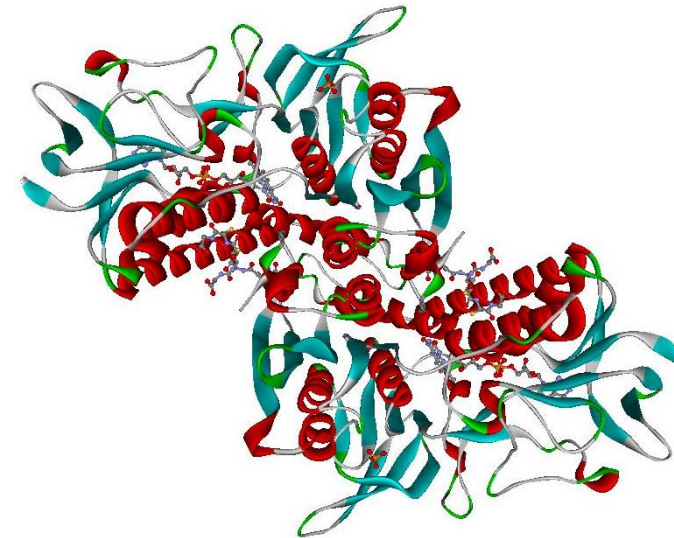
Cofatores

íon	Exemplos de proteínas que contém íons
Cupric	Cytochrome oxidase
Ferrous or Ferric	Catalase
	Cytochrome (via Heme)
	Nitrogenase Hydrogenase
Magnesium	Glucose 6-phosphatase
	Hexokinase
Manganese	Arginase
Molybdenum	Nitrate reductase
Nickel	Urease
Selenium	Glutathione peroxidase
	Alcohol dehydrogenase
	Carbonic anhydrase DNA polymerase
Zinc	

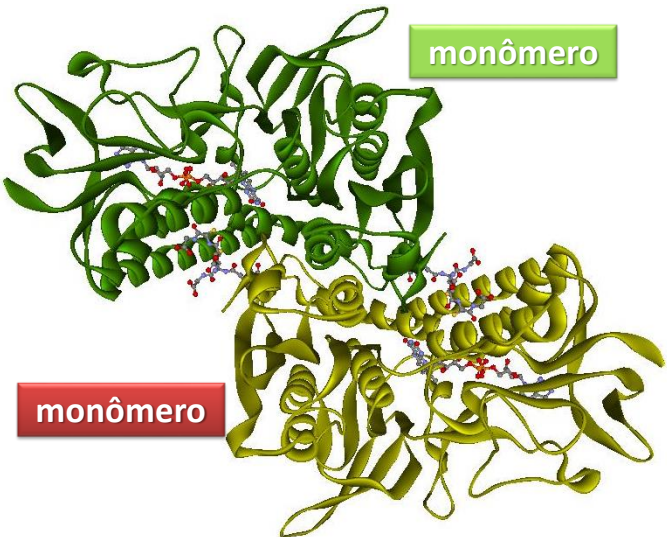
Coenzima

- são pequenas moléculas orgânicas, não-protéicas que transportam grupos químicos entre enzimas.
- algumas vezes são chamadas de *co-substratos*.
- *não* fazem parte permanente da enzima.
- **coenzima** \neq cofator.

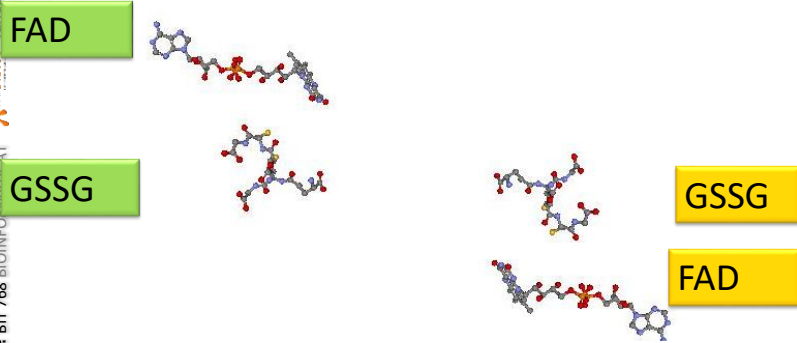
Glutaciona Redutase

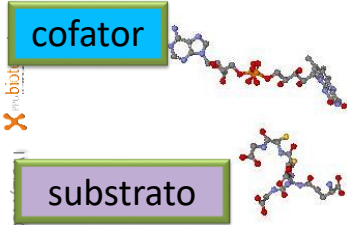


Glutaciona Redutase

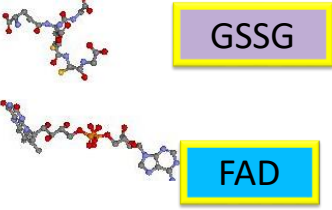


Glutaciona Redutase

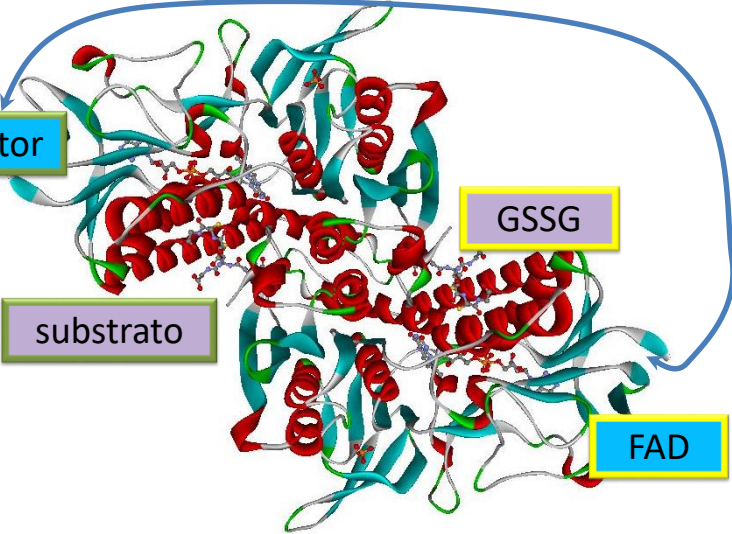




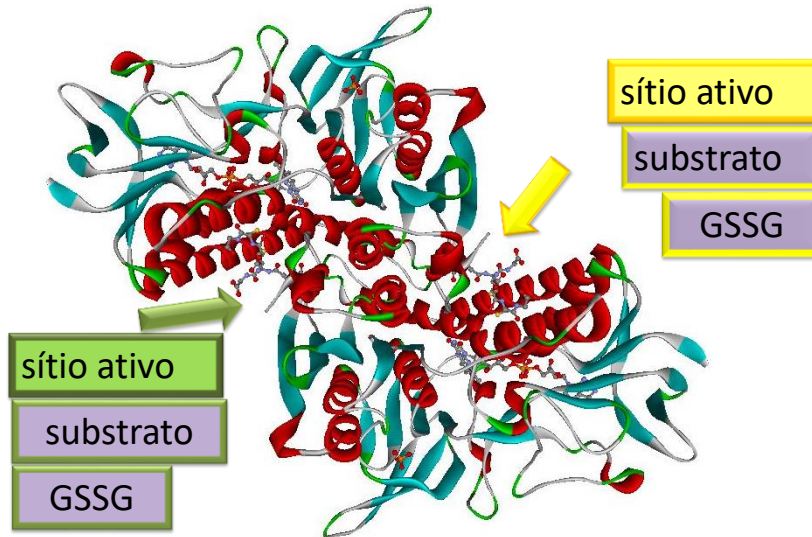
Glutaciona Redutase



Glutaciona Redutase



Glutaciona Redutase

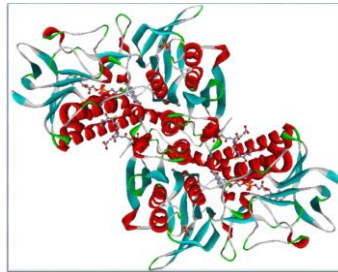
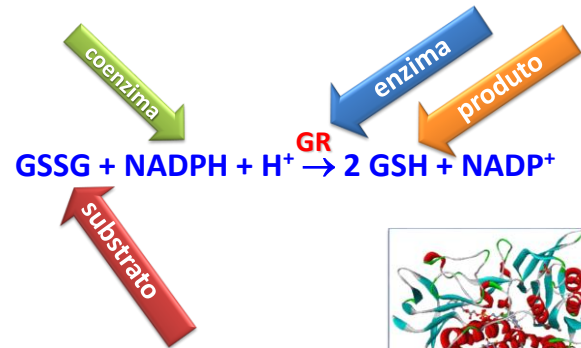


Glutaciona Redutase

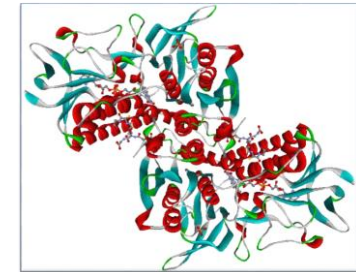
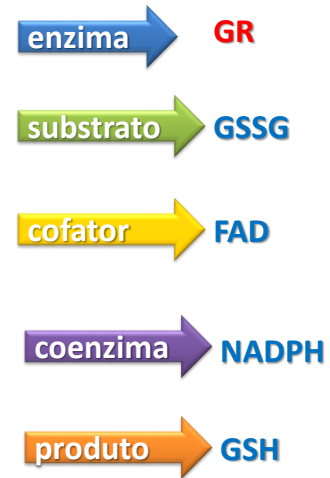


enzima homodimérica → 500 aa / monômero
 flavoproteínas: grupo prostético → FAD
 coenzima: NADPH

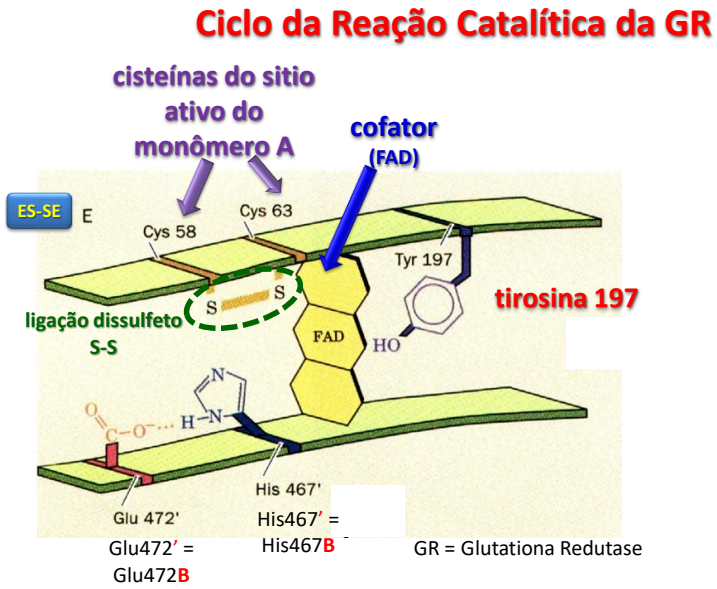
Glutaciona Redutase (GR)



Glutaciona Redutase (GR)



a

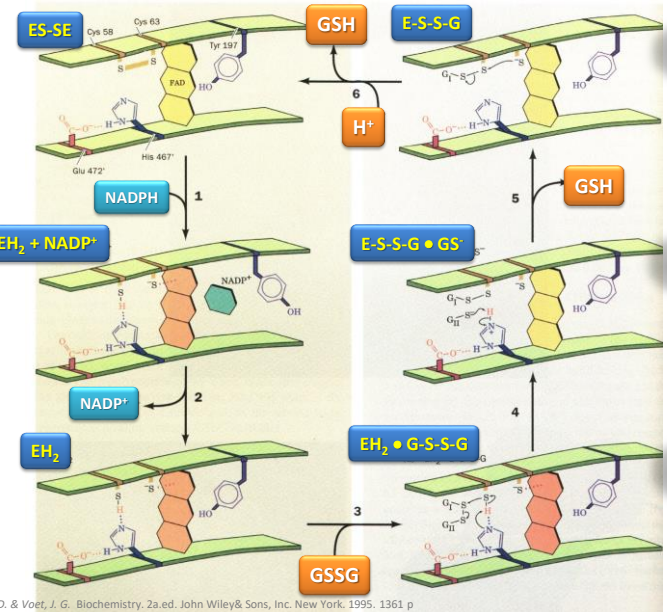


a

b

c

Ciclo da Reação Catalítica da GR



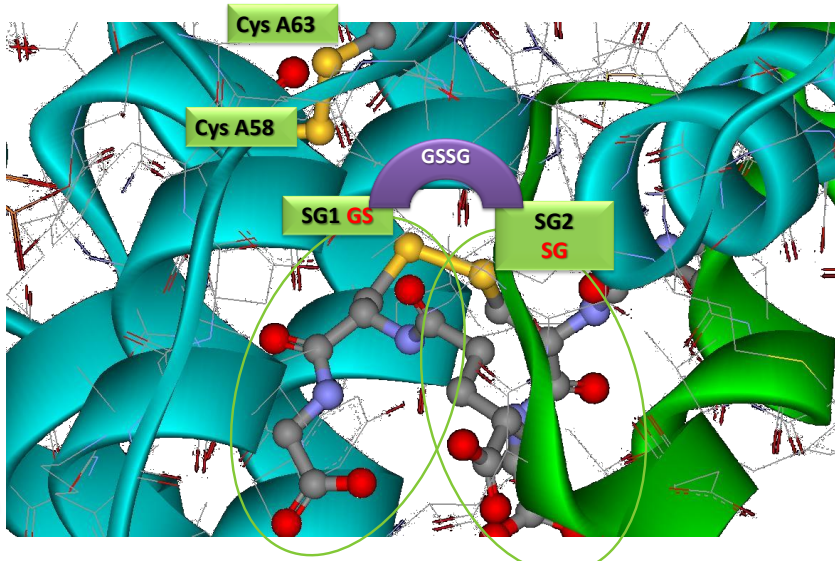
f

e

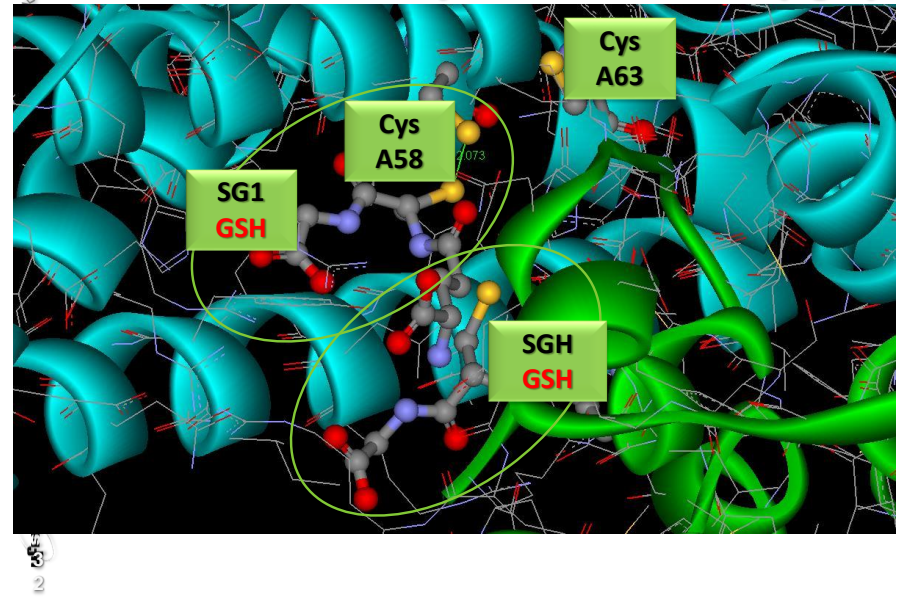
d

adaptado de Voet, D. & Voet, J. G. Biochemistry. 2a.ed. John Wiley& Sons, Inc. New York. 1995. 1361 p

Ciclo da Reação Catalítica da GR (1gra)

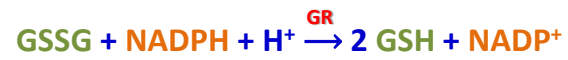


Ciclo da Reação Catalítica da GR (1gre)



Exercício sala de aula

A reação que ocorre pode ser assim resumida



- Vamos comparar as moléculas

molécula	1gra	1gre	1xan	3sqp
fonte (organismo)				
código enzima				
substrato				
cofator				
coenzima				
ligantes				
resolução				