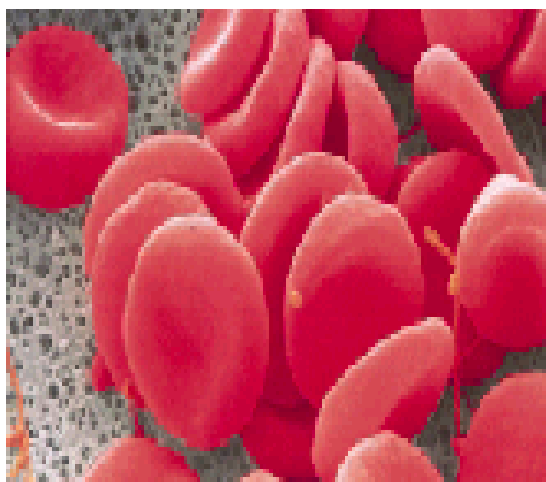
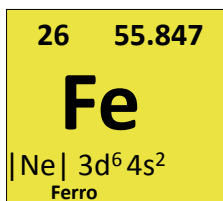


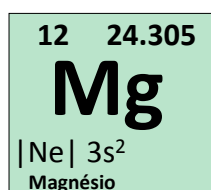
O sangue é
vermelho



Porquê?

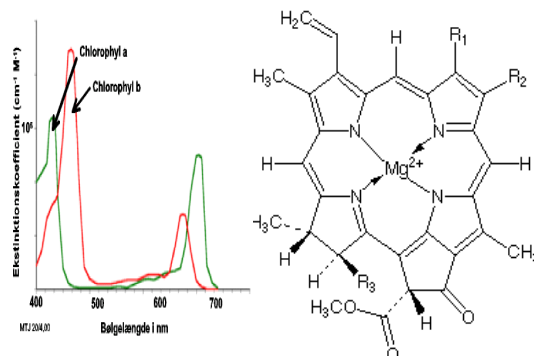
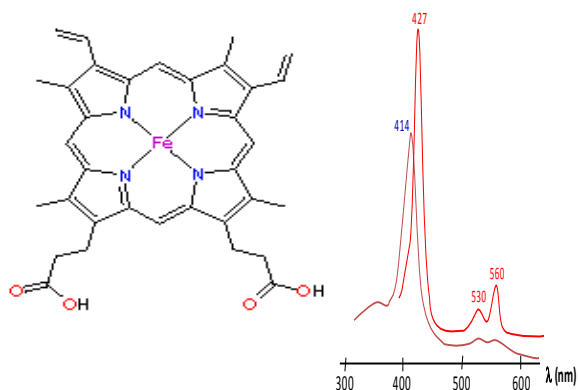


A relva é
verde



CLORINA

PORFIRINA



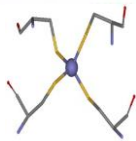
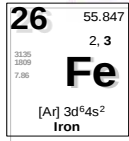
Hemoglobina

Clorofila

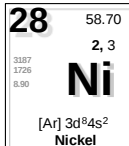
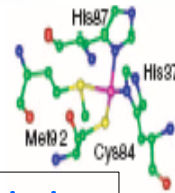
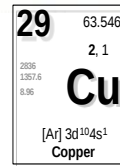


Onde absorvem

Aprender



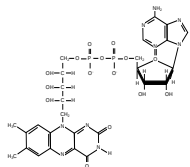
$\lambda(\text{nm})$



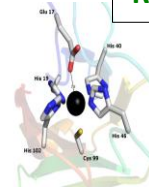
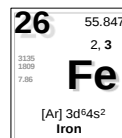
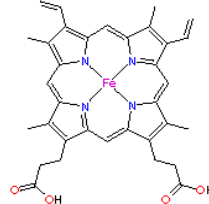
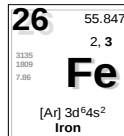
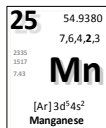
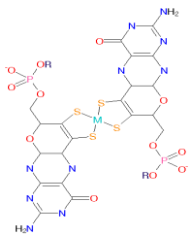
Rubredoxina
Rubreritrina

Plastocianina
Azurina

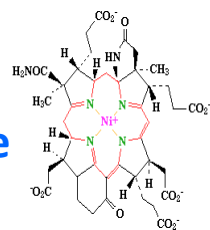
Urease
Metil-Coenzima M
Reductase



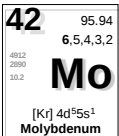
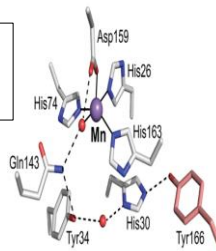
Flavodoxina



Superóxido re

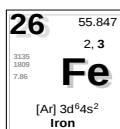


Superoxide
Dismutase (Mn)

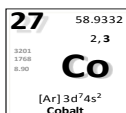
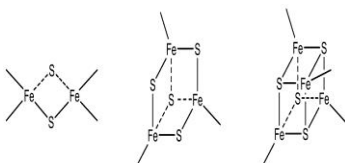


Nitrogenase
Aldeído Oxidoreductase

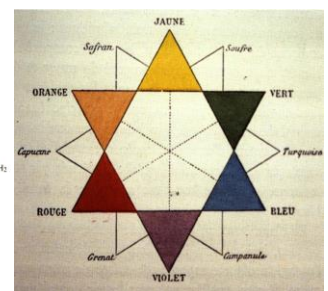
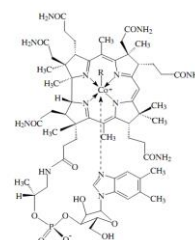
Descobre a sua cor



Proteínas com centros
Ferro-Enxofre



Glutamase mutase
Metionina Sintase
dependente de
cobalamina



Avançado

Biologia

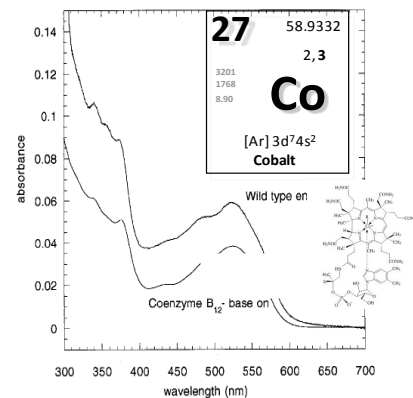
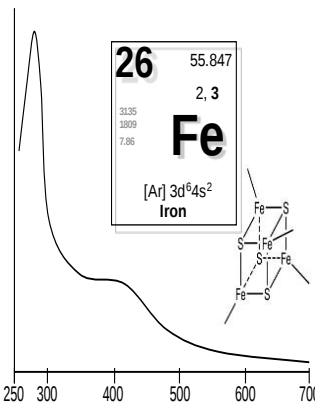
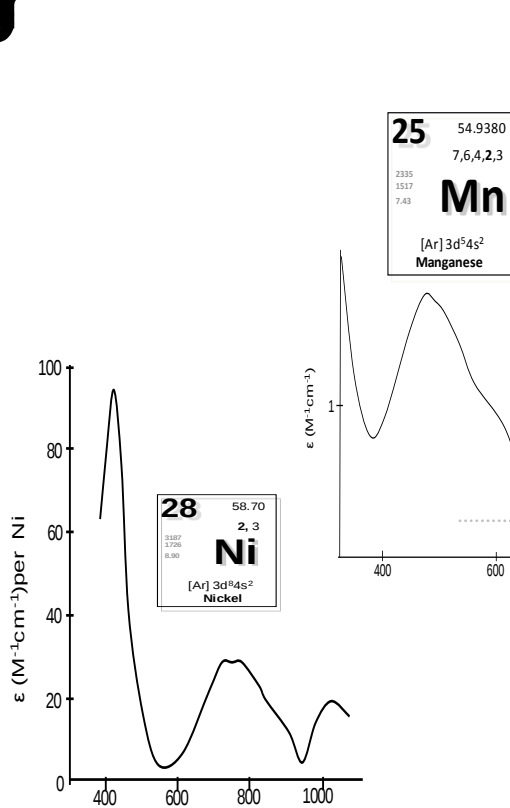
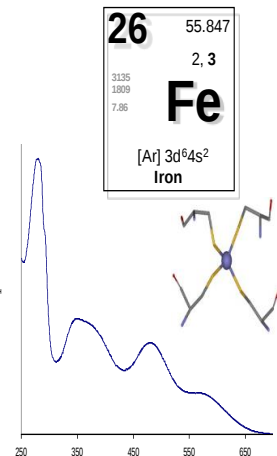
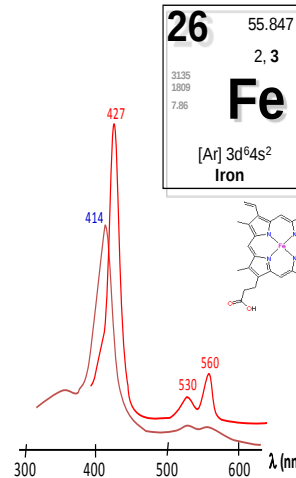
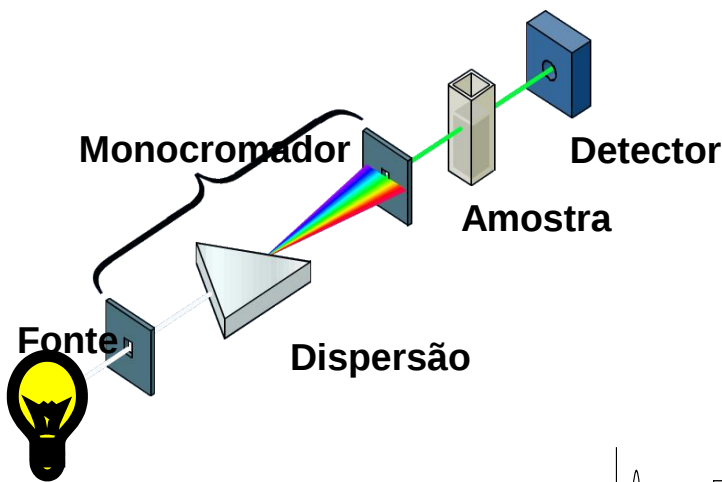
www.itqb.unl.pt/experimenta



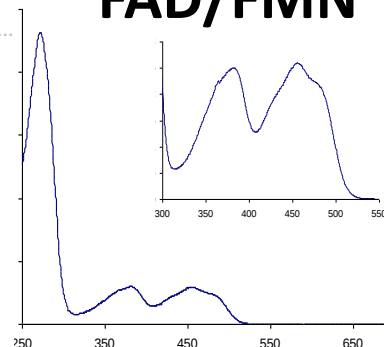
Aprender

Como estudar ? métodos espectroscópicos

Espectroscopia de UV-Visível



FAD/FMN



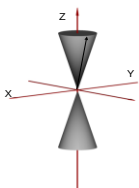
Avançado

Biologia



Aprender

Espectroscopia de Ressonância Paramagnética Electrónica



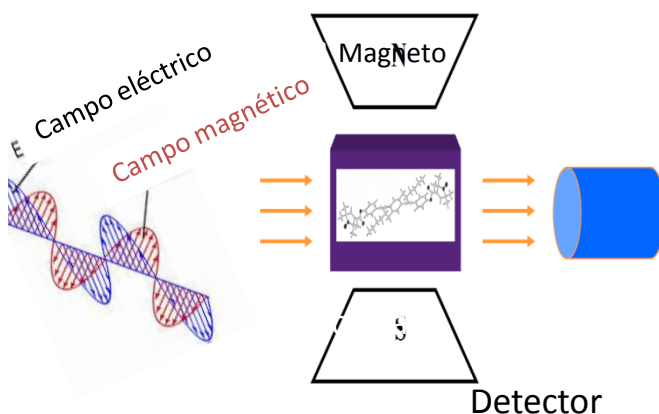
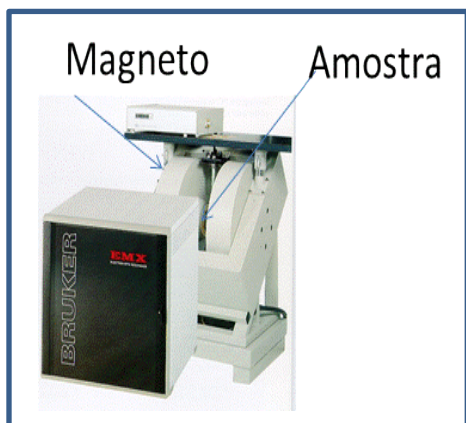
Fonte de energia: Radiação de microondas

Deteção: Absorção de microondas na presença de um campo magnético

Amostra: *In vivo* e *in vitro*- Soluções, tecidos, células, pó, cristais

Princípio: Electrões desemparelhados numa molécula
- inversão do momento magnético

Informação: Estrutura e propriedades de moléculas, mecanismos de reacção, catálise, ...(fotossíntese, respiração, radicais"livres", metais, enzimas, compostos e materiais,...)



Fonte de microondas

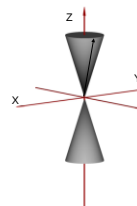
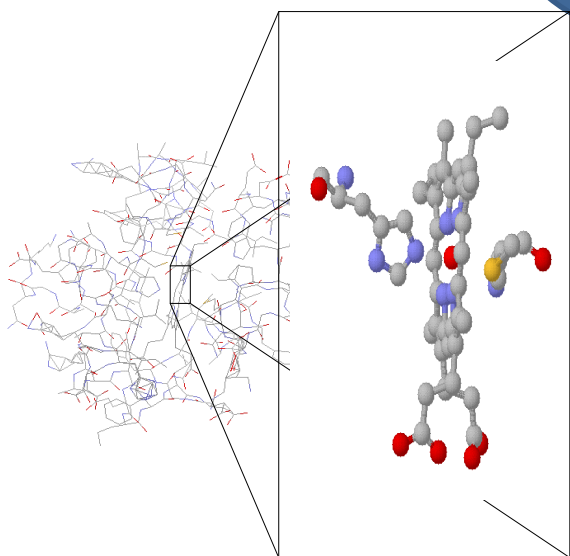


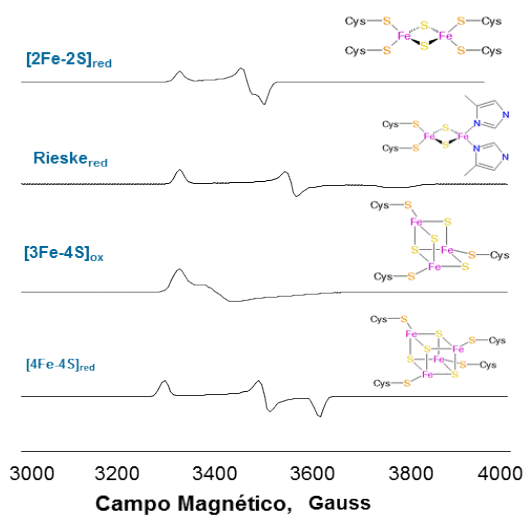
Tabela Periódica do RPE em Biologia

[illegible][illegible]

Metais e radicais



RPE de Centros de Ferro-Enxofre



Especificidade- apenas o centro activo é observado

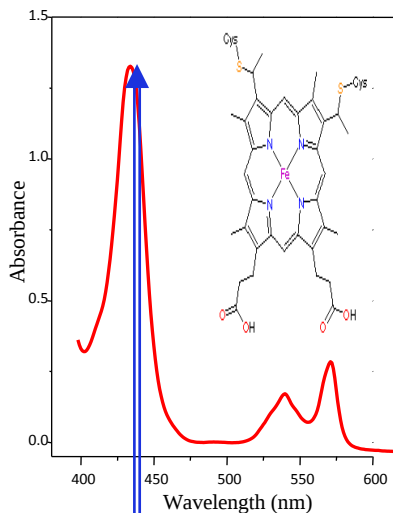
Avançado

Biologia



Espectroscopia de Raman de ressonância

Espectro de UV-Vis de uma proteína hémica

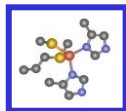
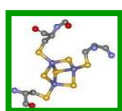
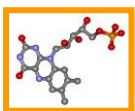


λ_{laser} **413nm**

O laser é a fonte de excitação do espectro de Raman

Quando utilizamos o laser cuja energia corresponde à da banda de espectro de UV-Vis, a espectroscopia de Raman de ressonância revela os pormenores sobre a ligação e o estado de oxidação do cromóforo, neste caso - grupo hémico

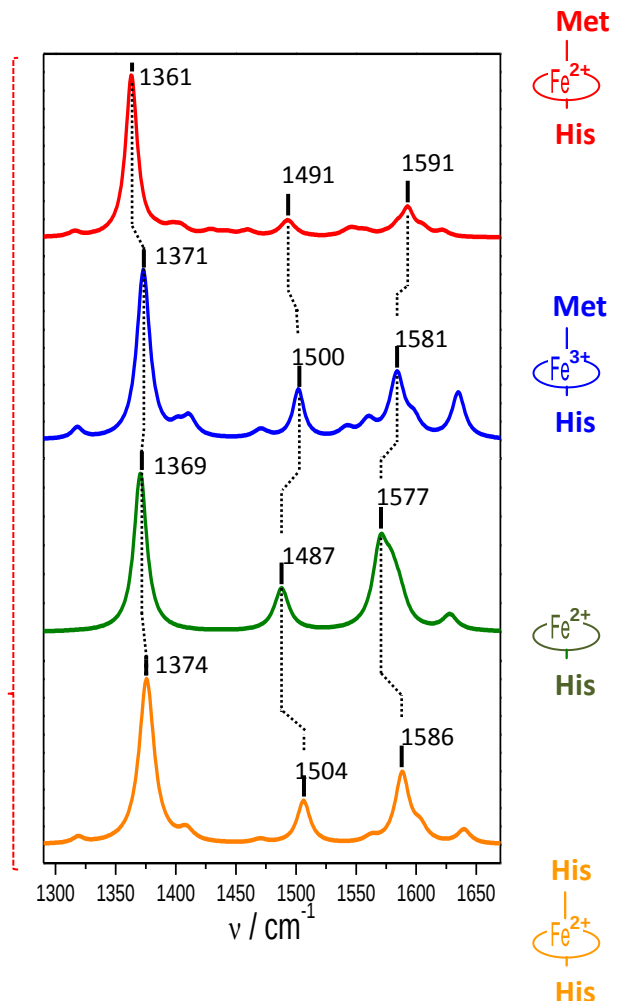
Os espectros das outras proteínas que contêm:



flavina, ferro-enzofre ou cobre

são obtidos com os lasers de 458nm, 413nm e 568nm, respetivamente.

Espectros de Raman de ressonância da proteína hémica - citocromo c



Met
Fe²⁺
His

Met
Fe³⁺
His

Fe²⁺
His

His
Fe²⁺
His