International Centre
for Theoretical Physics
South American Institute
for Fundamental Research

Biofísica

Utilizando a luz polarizada para investigar proteínas

Escola de Verão ICTP-SAIFR para Jovens Físicos

Grupo:

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- Geovany Nunes;
- Paula Santos;
- Pedro Silva;
- Tarcísio Ferreira

Motivação

Enquanto fazíamos o ENEM...

Semanas atrás...

Brasil Estadão

Compra de seringas fracassa e Ministério da Saúde garante menos de 3% do necessário para a vacinação

Das 331 milhões de unidades previstas, governo só conseguiu oferta para 7,9 milhões; Pazuello prevê começar imunização só em fevereiro.

2 semanas atrás

G1 G1

Governo federal suspende exportação de seringas e agulhas

Medida foi adotada por serem produtos necessários para a vacinação contra a Covid-19. Pregão do Ministério da Saúde só conseguiu ...

1 semana atrás

Jornal O Globo

Covid-19: Saúde demorou para responder oferta de seringas da Opas e escolheu frete mais demorado

Pasta levou três meses para responder se desejaria comprar 40 milhões de seringas;

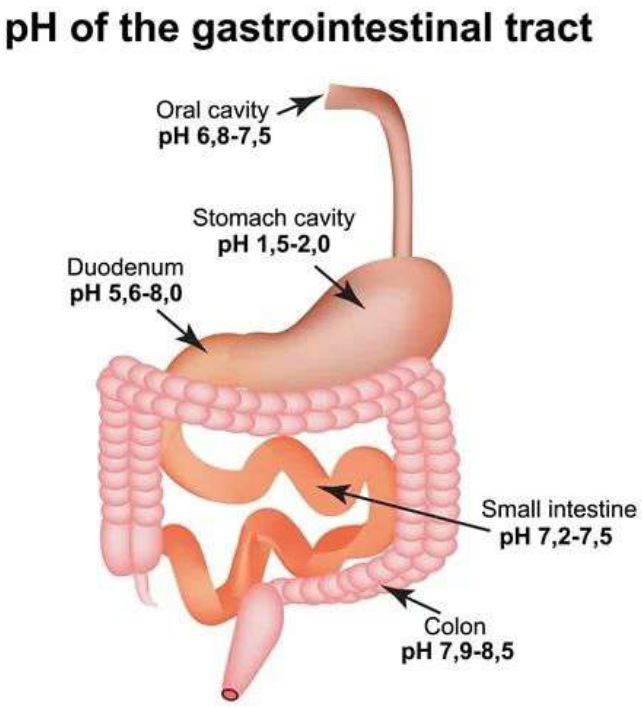
4 horas atrás

Existe alguma solução para este problema?

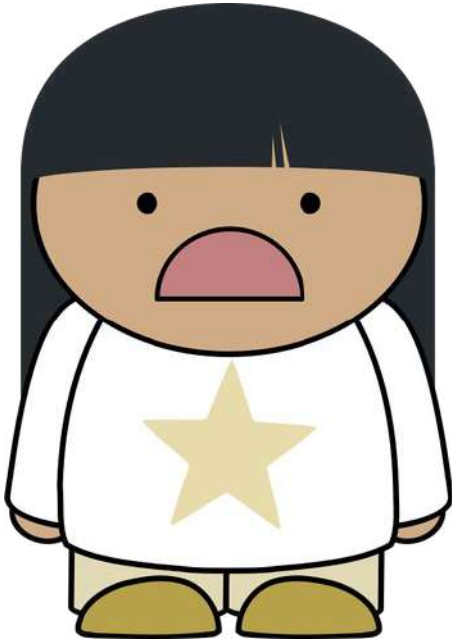
Herói nacional

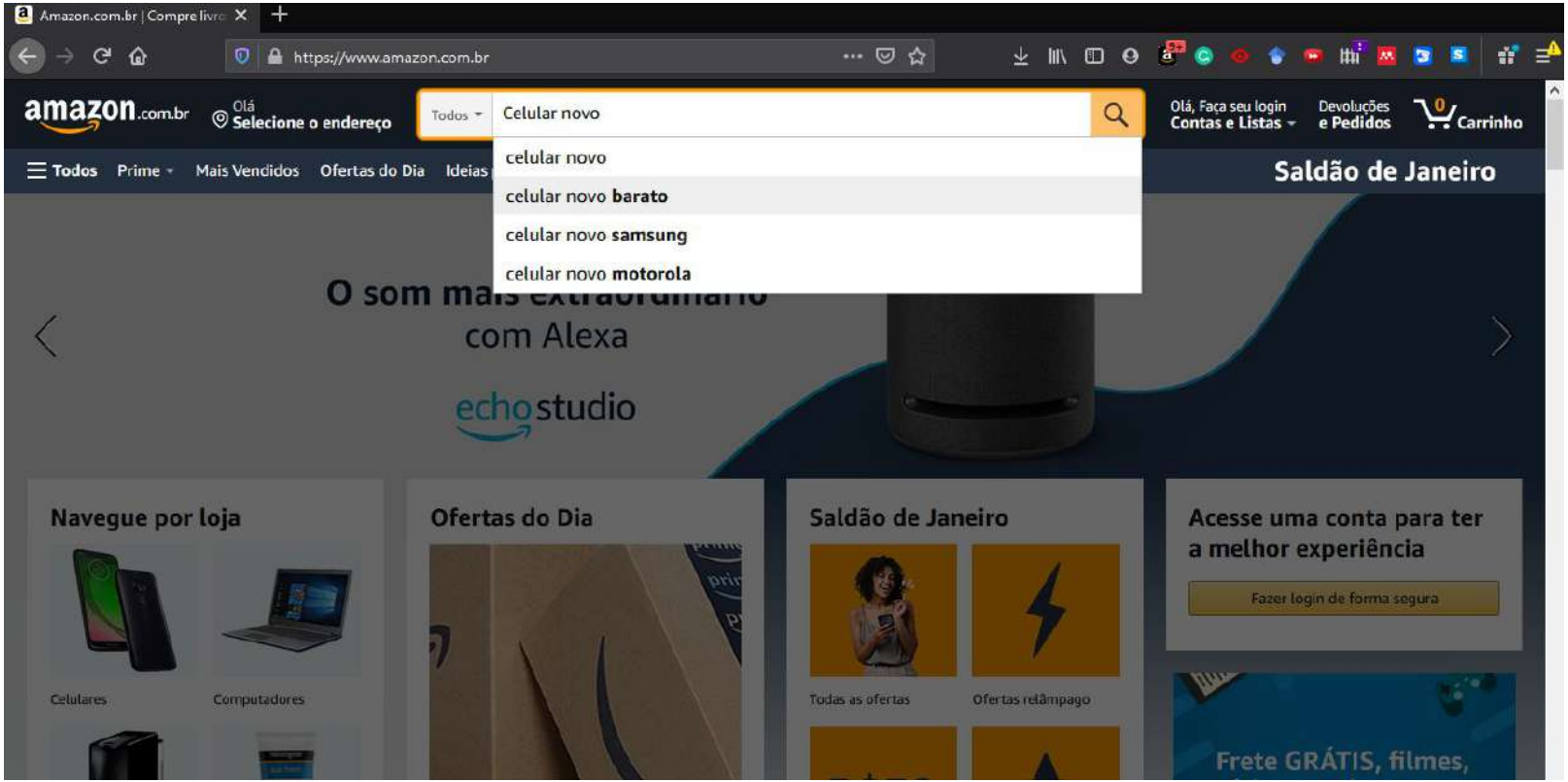
Podemos "tomar" a coronavac?

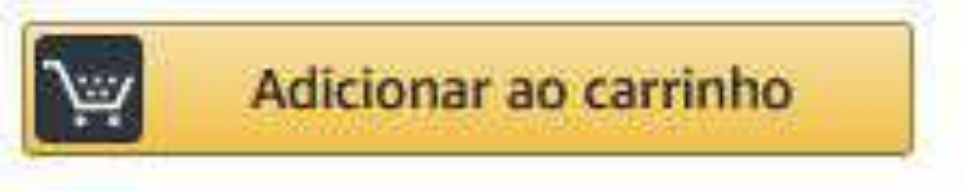
Níveis de pH após a ingestão

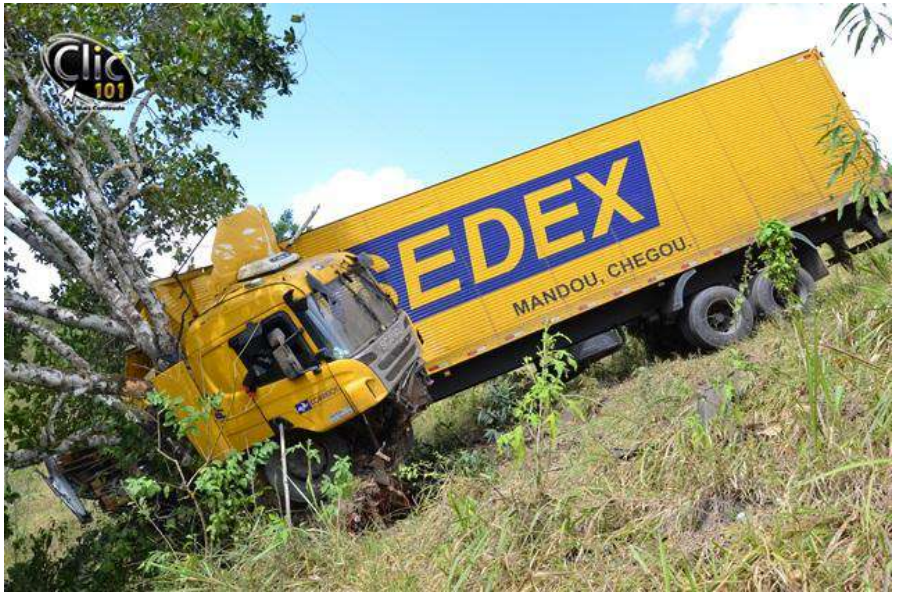


O QUE A VACINA PARA SER INGERIDA TEM DE TÃO ESPECIAL?

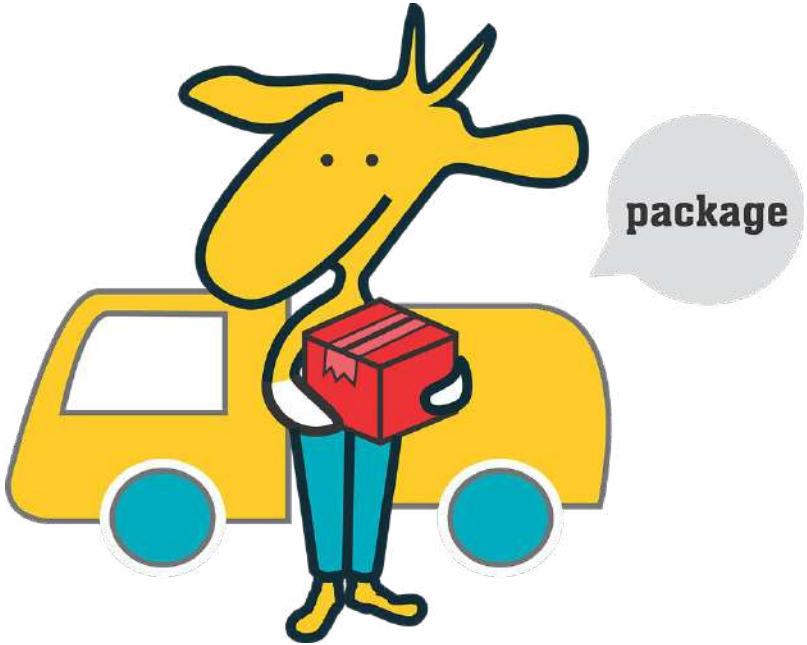



Amazon.com.br | Compre livro
https://www.amazon.com.br
amazon.com.br
Olá
Selecione o endereço
Todos
Celular novo
celular novo
celular novo barato
celular novo samsung
celular novo motorola
Olá, Faça seu login
Contas e Listas
Devoluções
e Pedidos
Carrinho
Todos
Prime
Mais Vendidos
Ofertas do Dia
Ideias
Saldão de Janeiro
O som mais extraordinário
com Alexa
echo studio
Navegue por loja
Celulares
Computadores
Ofertas do Dia
Saldão de Janeiro
Todas as ofertas
Ofertas relâmpago
Acesse uma conta para ter a melhor experiência
Fazer login de forma segura
Frete GRÁTIS, filmes,


Adicionar ao carrinho


Clic 101
SEDEX
MANDOU, CHEGOU.

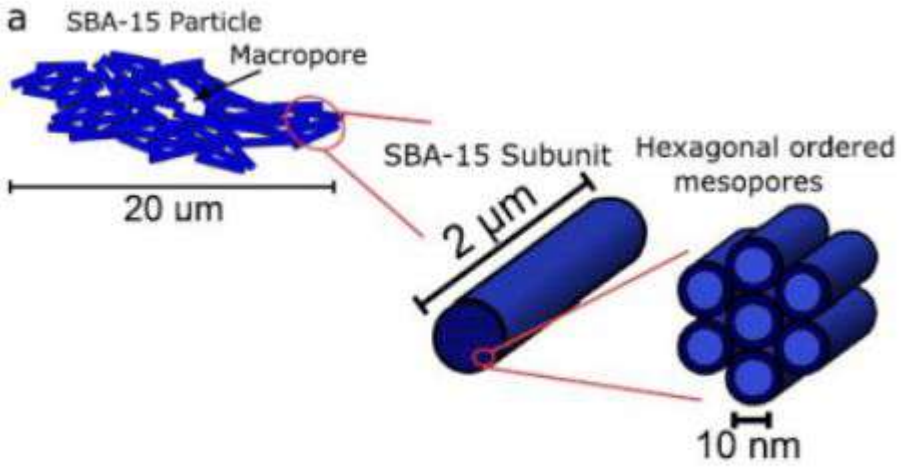
8:15
Tuesday, April 6


package

Como fazer isso com um antígeno?

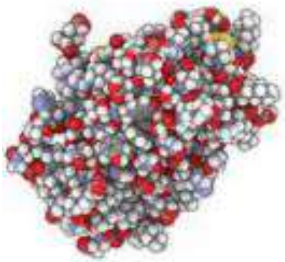
SBA 15

- **Área superficial:** >800m^2/g
- **Volume de poros:** >1cm^3/g
- **Diâmetro de poros:** ajustável 8<d<50nm
- **Simetría 2D dos mesoporos**: Hexagonal
- **Porosidade:** micro(<2nm), meso(2<d<50nm) macro(>50nm)

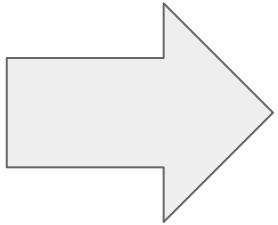


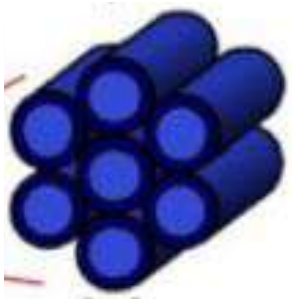
3D Visualization of hepatitis B vaccine in the oral delivery vehicle SBA-15. M. Rasmussen; C. Oliveira, M. Fantini; et al. Nature (2019)

Perguntas de pesquisa



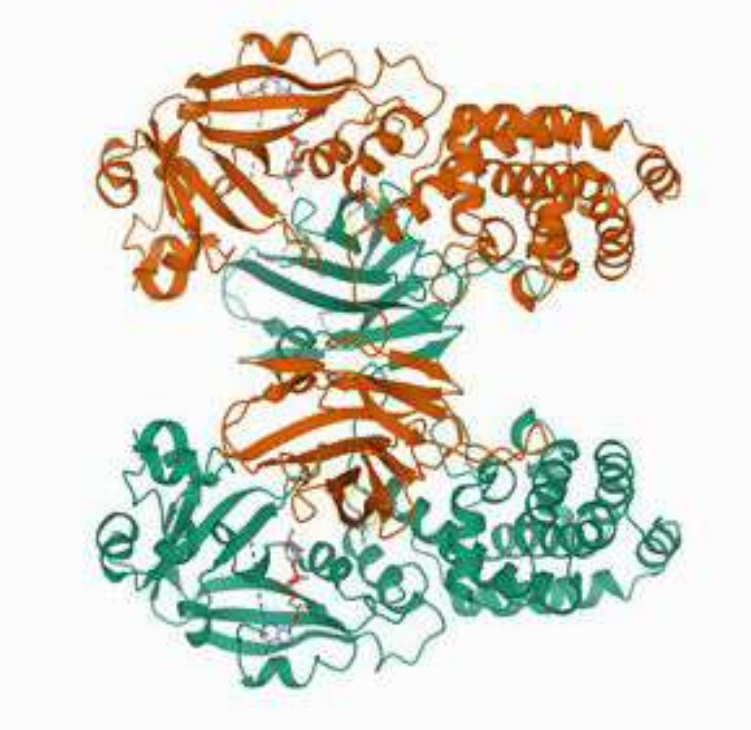
Protein



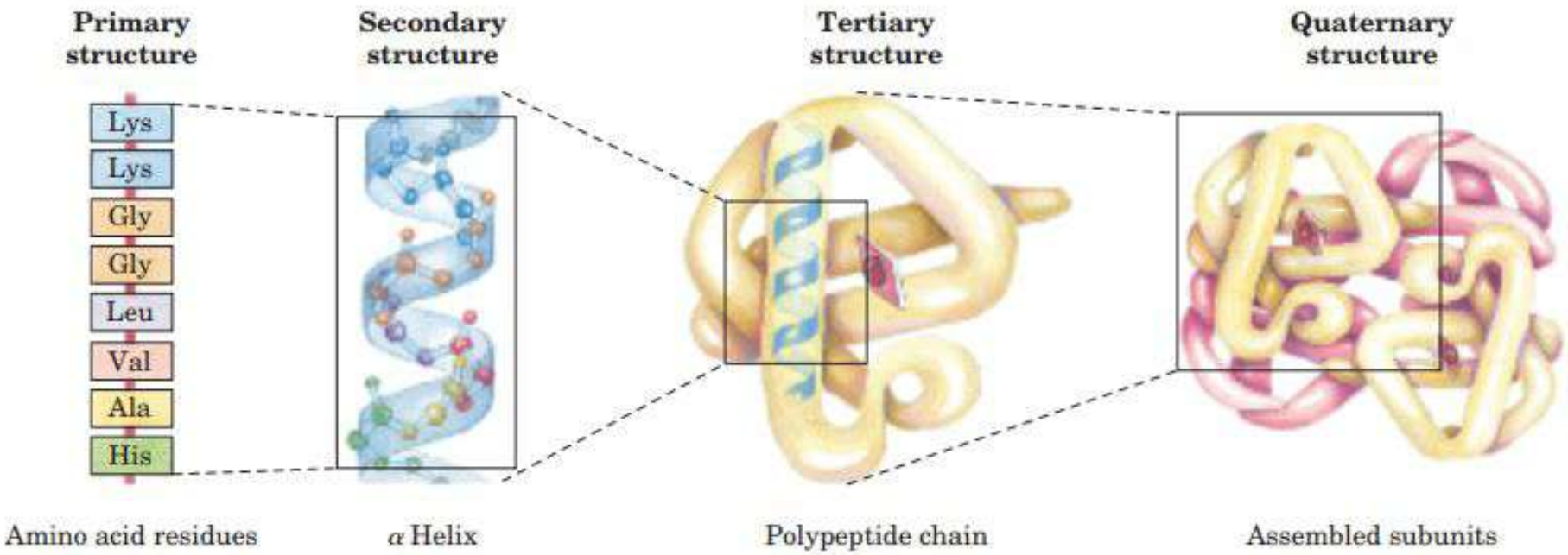


Fonte: Peptide Sciences

Vacina da difteria (DANA):



Proteínas

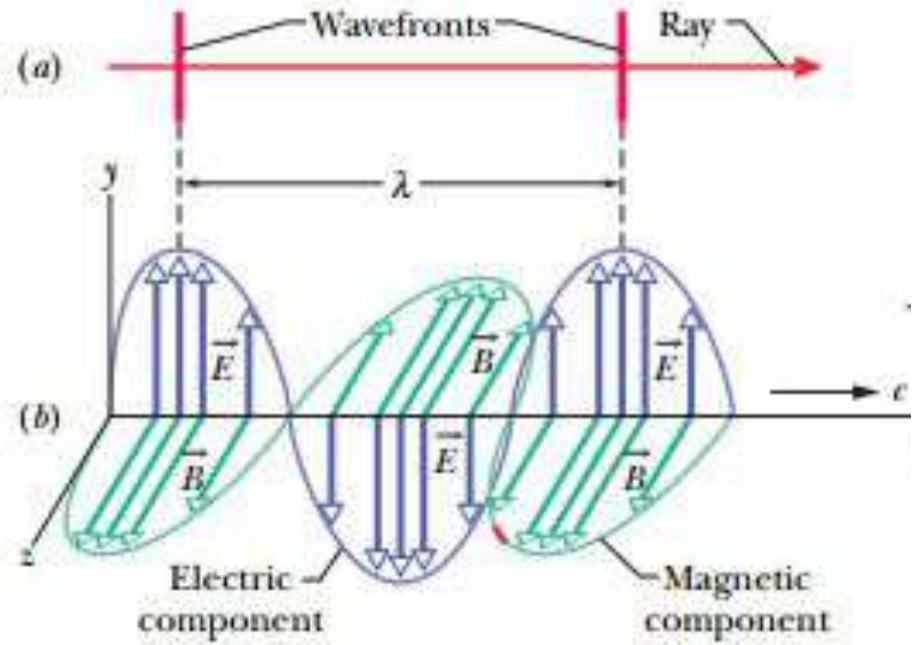


Níveis de estrutura proteica (Lehninger. 4º ed.)

Como a luz pode ajudar?

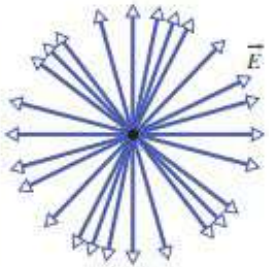
A TRANSVERSALIDADE DA LUZ

$$E = E_m \sin(kx - \omega t), \qquad (33\text{-}1)$$

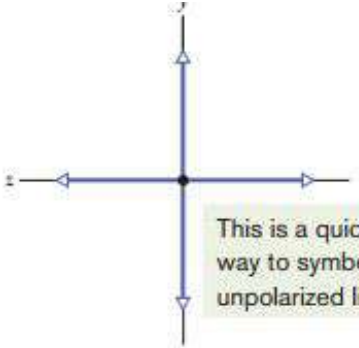


A TRANSVERSALIDADE DA LUZ

Unpolarized light headed toward you—the electric fields are in all directions in the plane.



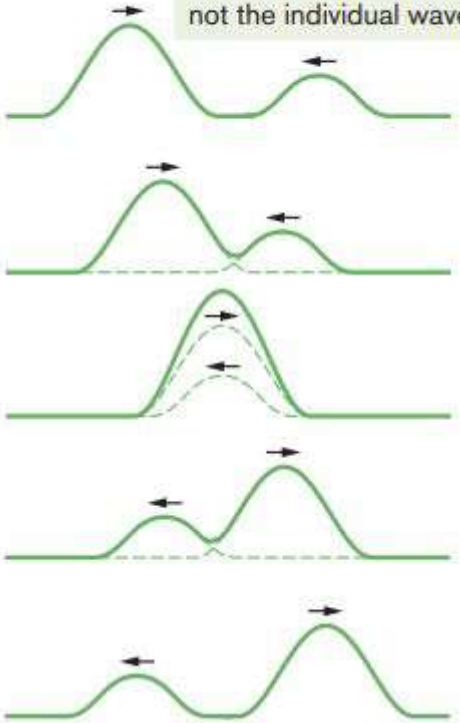
(a)



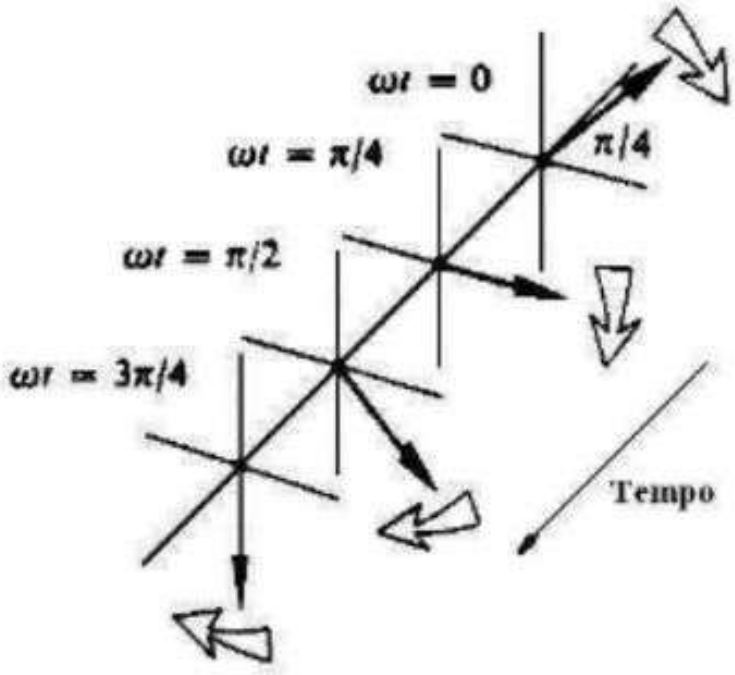
(b)

This is a quick way to symbolize unpolarized light.

When two waves overlap, we see the resultant wave, not the individual waves.



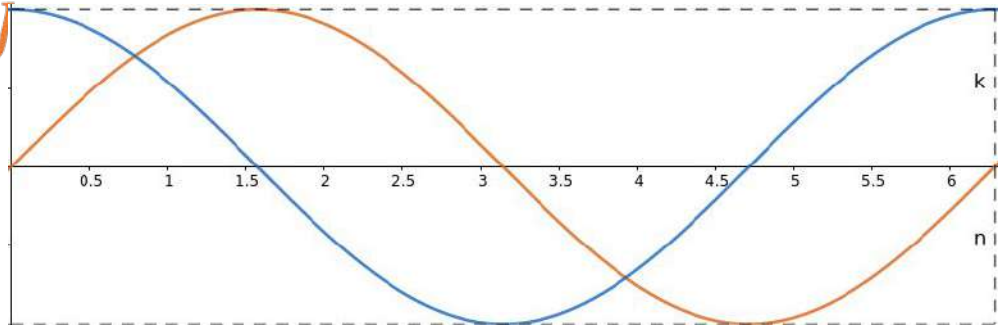
Luz circularmente polarizada

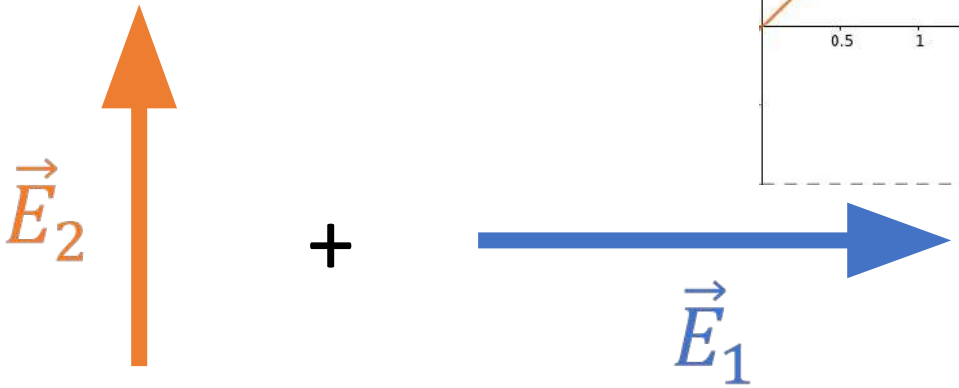


Luz circularmente polarizada

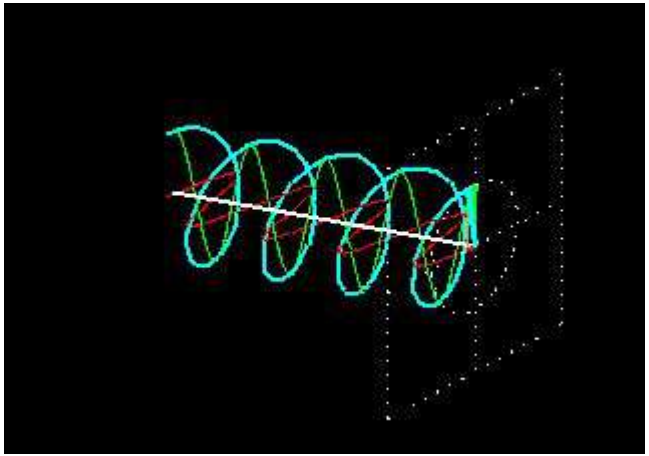
$$\vec{E}_1 = ESen\left(kx + \omega t + \frac{\pi}{2}\right)\hat{\imath}$$

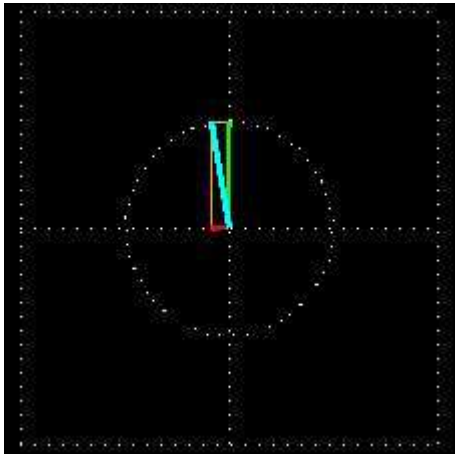
$$\vec{E}_2 = ESen(kx + \omega t)\,\hat{\jmath}$$

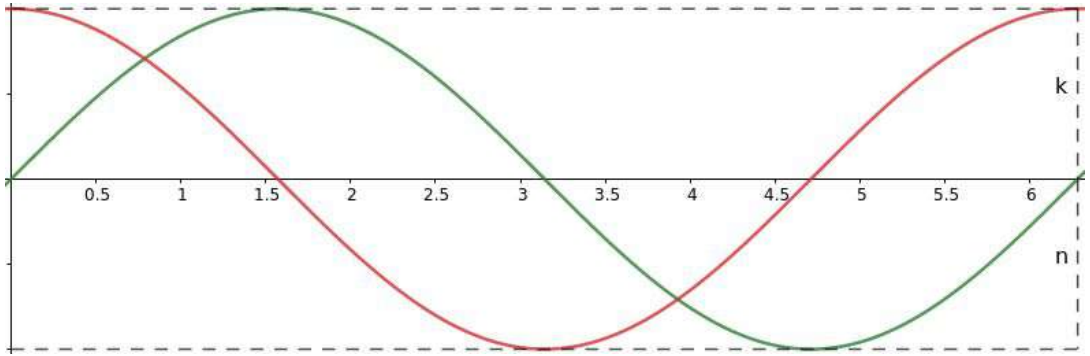




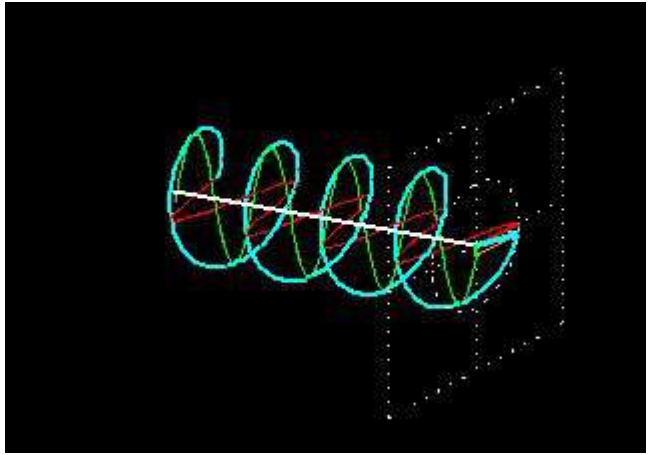
Luz circularmente polarizada





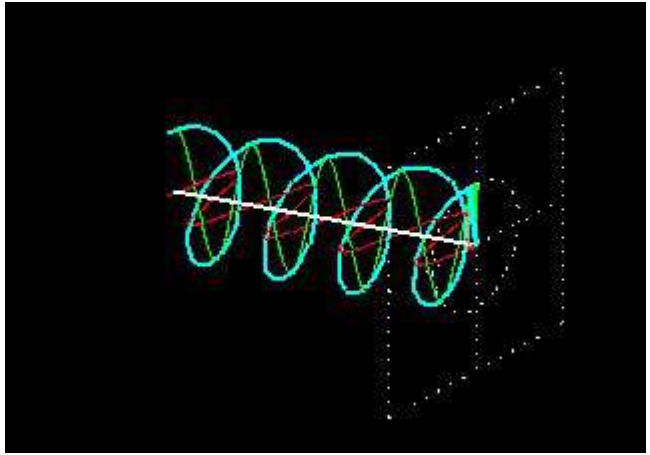


Luz circularmente polarizada



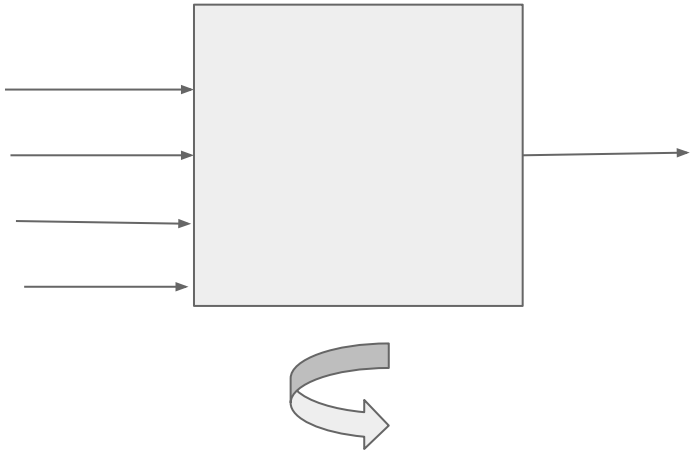
Fonte: https://cddemo.szialab.org/

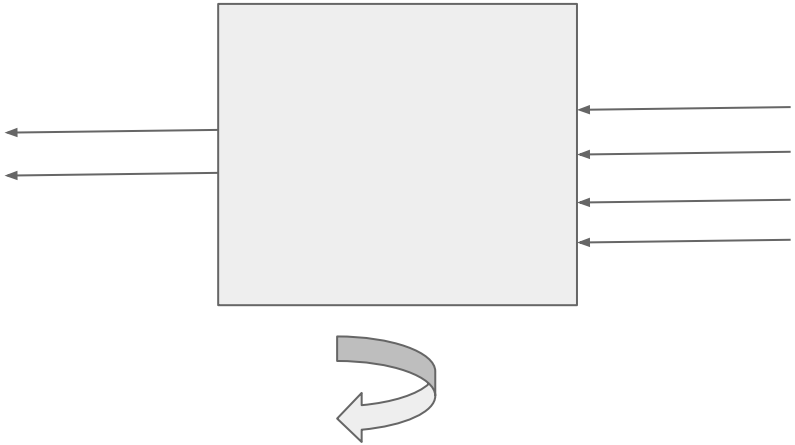
ESQUERDA



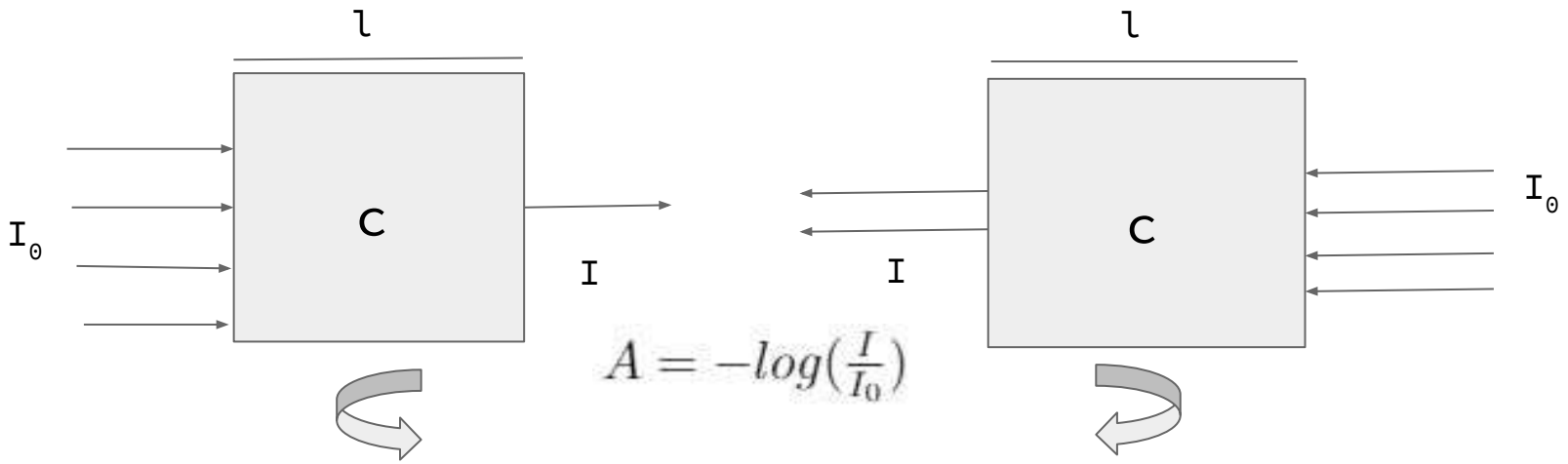
DIREITA

O DICROISMO CIRCULAR (CD)





O DICROISMO CIRCULAR



$$A = -log(\frac{I}{I_0})$$

Lei de Lambert-Beer: $A = c \cdot l \cdot \epsilon$

$$A_d = c \cdot l \cdot \epsilon_d$$

$$A_e = c \cdot l \cdot \epsilon_e$$

$$\Delta A = A_d - A_e = c \cdot l \cdot (\epsilon_d - \epsilon_e)$$

$$\Delta A = c \cdot l \cdot \Delta\epsilon$$

$\Delta\epsilon = \epsilon_d - \epsilon_e \Longrightarrow$ baseado nas propriedades do material e da luz incidente

O DICROISMO CIRCULAR

Incide-se luz Polarizada Circularmente à Direita na amostra

Incide-se luz Polarizada Circularmente à Esquerda na amostra

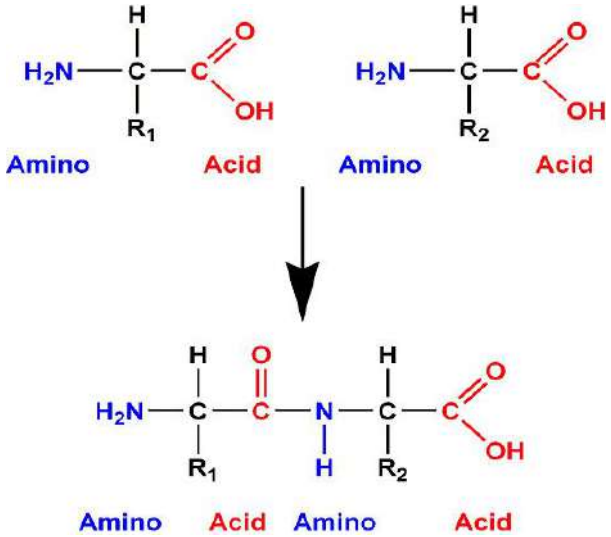
Varia-se o λ em ambos os casos

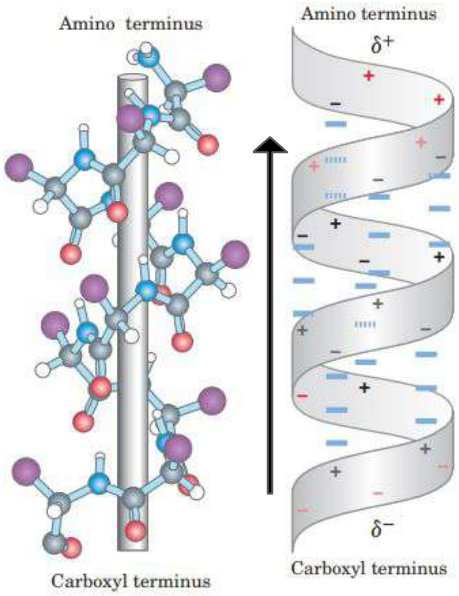
Utilizando as diferenças de absorbância, obtém-se o espectro de $\Delta\varepsilon$

De volta às proteínas

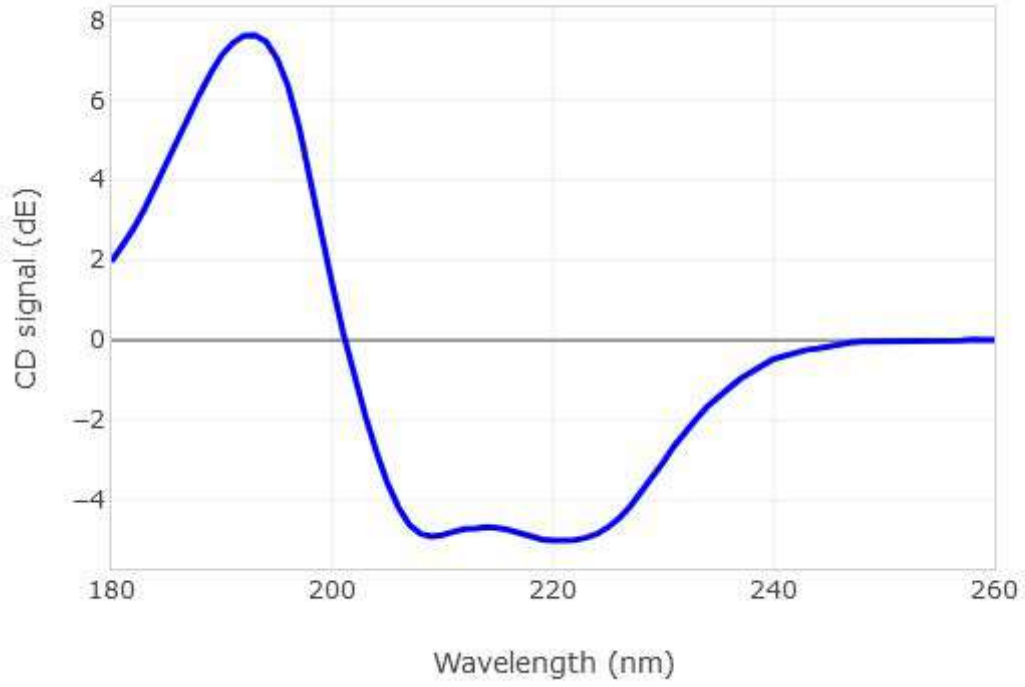
O QUE SÃO ESTRUTURAS ALFA HÉLICES

- Estrutura presente na proteína, formada por ligações de hidrogênio entre o grupo carboxílico e amina.

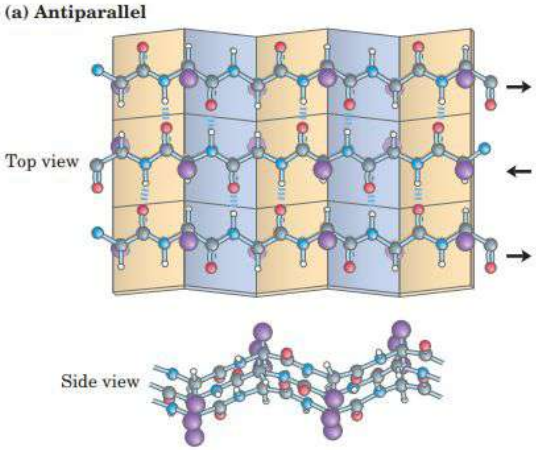


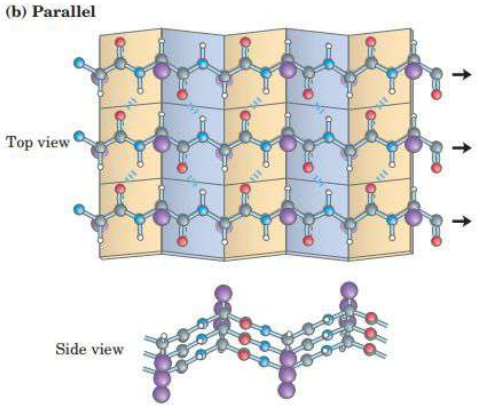


RESULTADOS DO CD EM ESTRUTURAS ALFA HÉLICE



O QUE SÃO FITAS BETAS

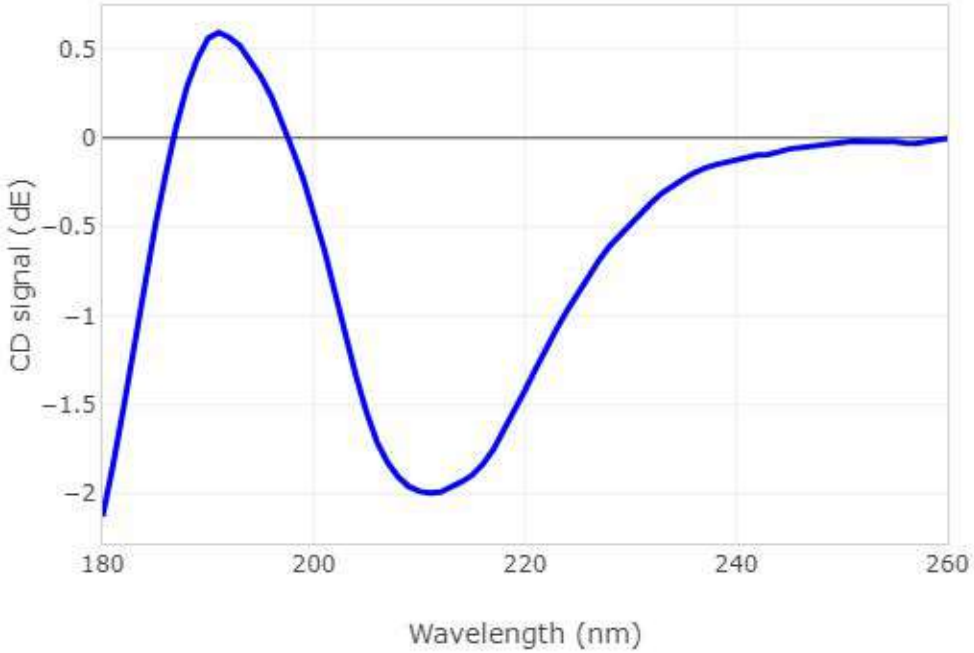




- Estruturas estabilizadas por pontes de hidrogênio entre grupamentos NH e CO em fitas peptídicas diferentes.

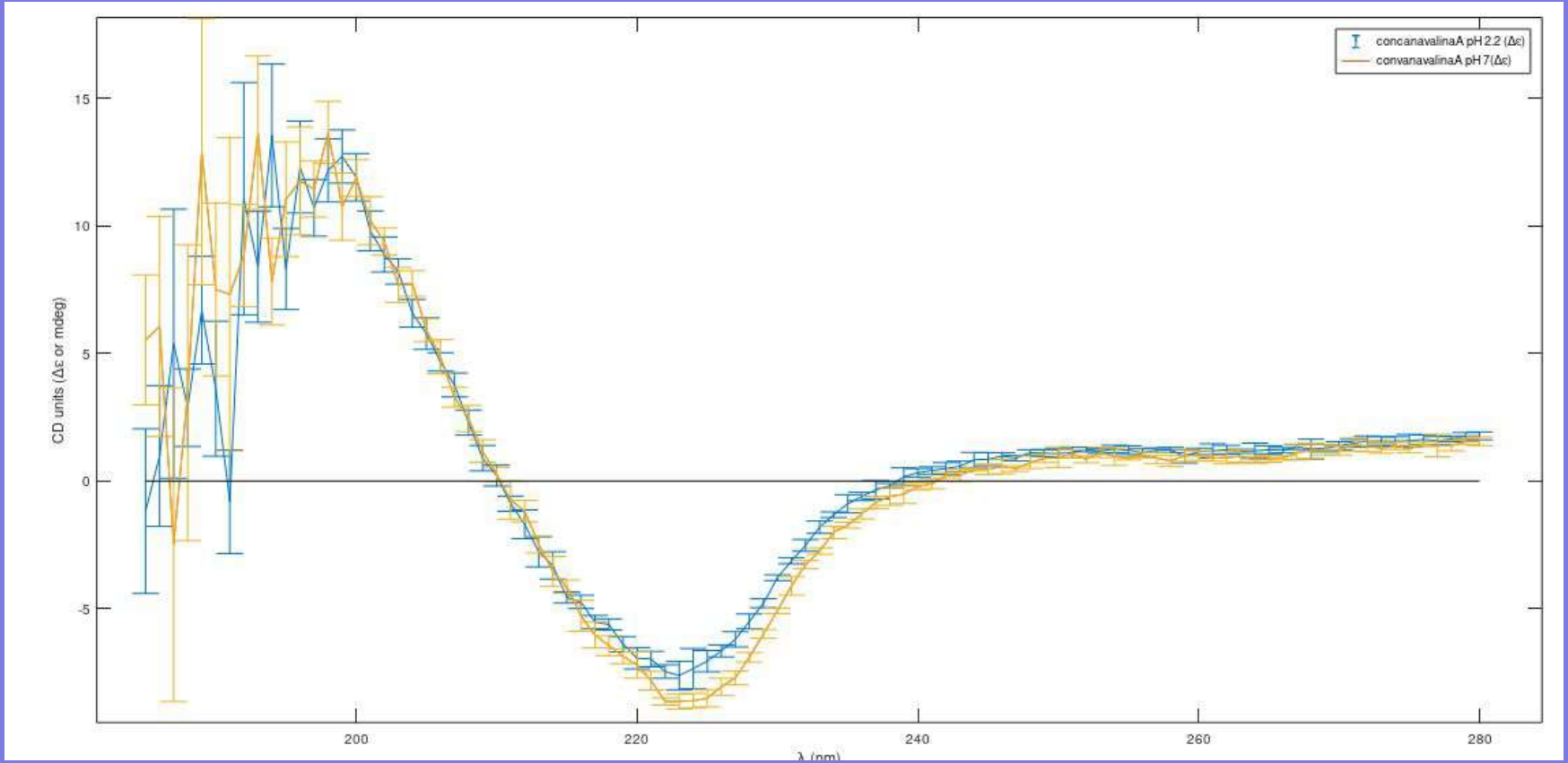
FIG.7 - Representação gráfica de fitas beta (Lehninger. 4º ed.)

Resultados do CD em estruturas Fitas Beta

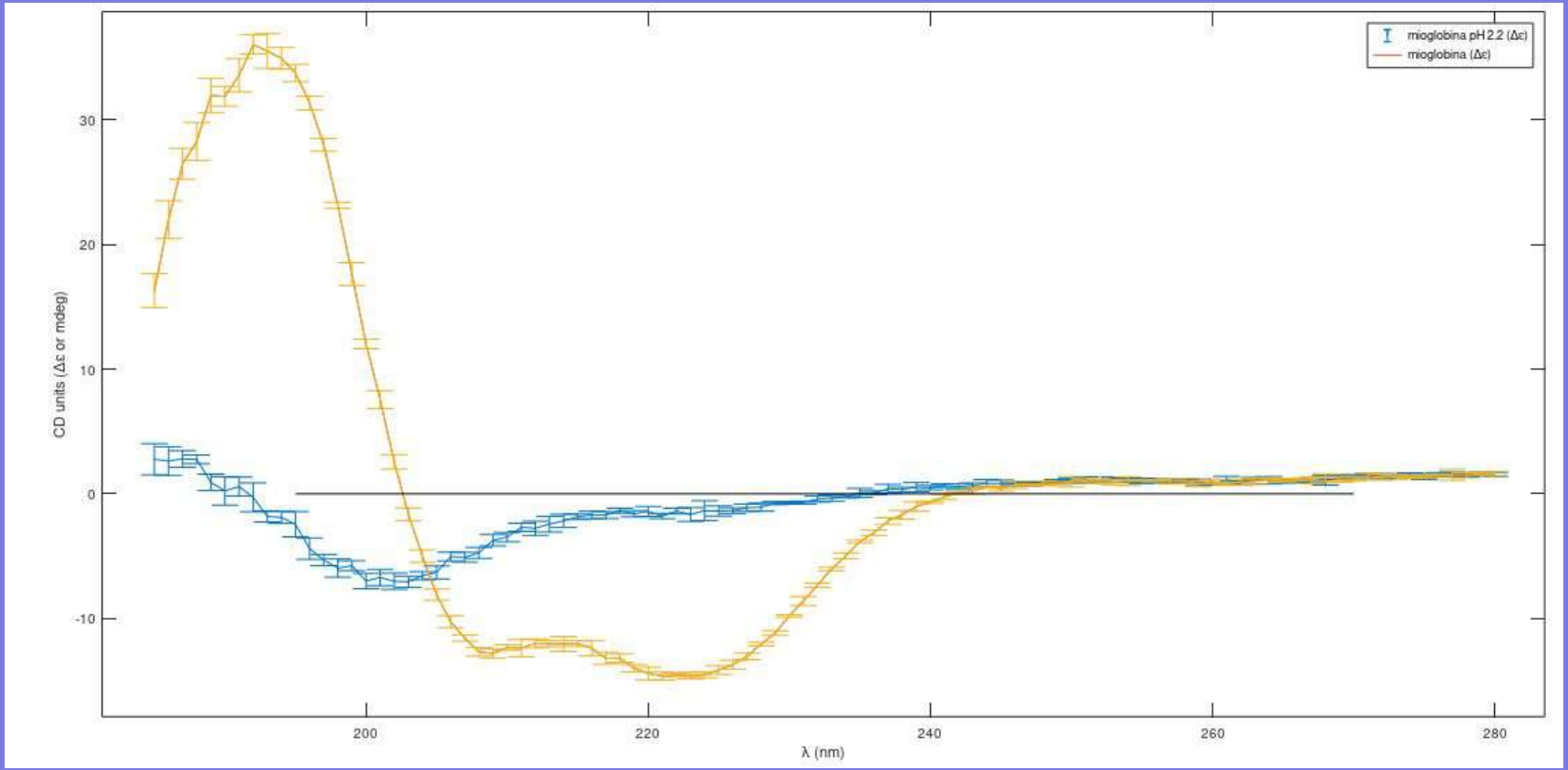


UMA VARIAÇÃO NO PH ALTERA O ESPECTRO DE CD?

Como a variação de pH afeta a concanavalina A

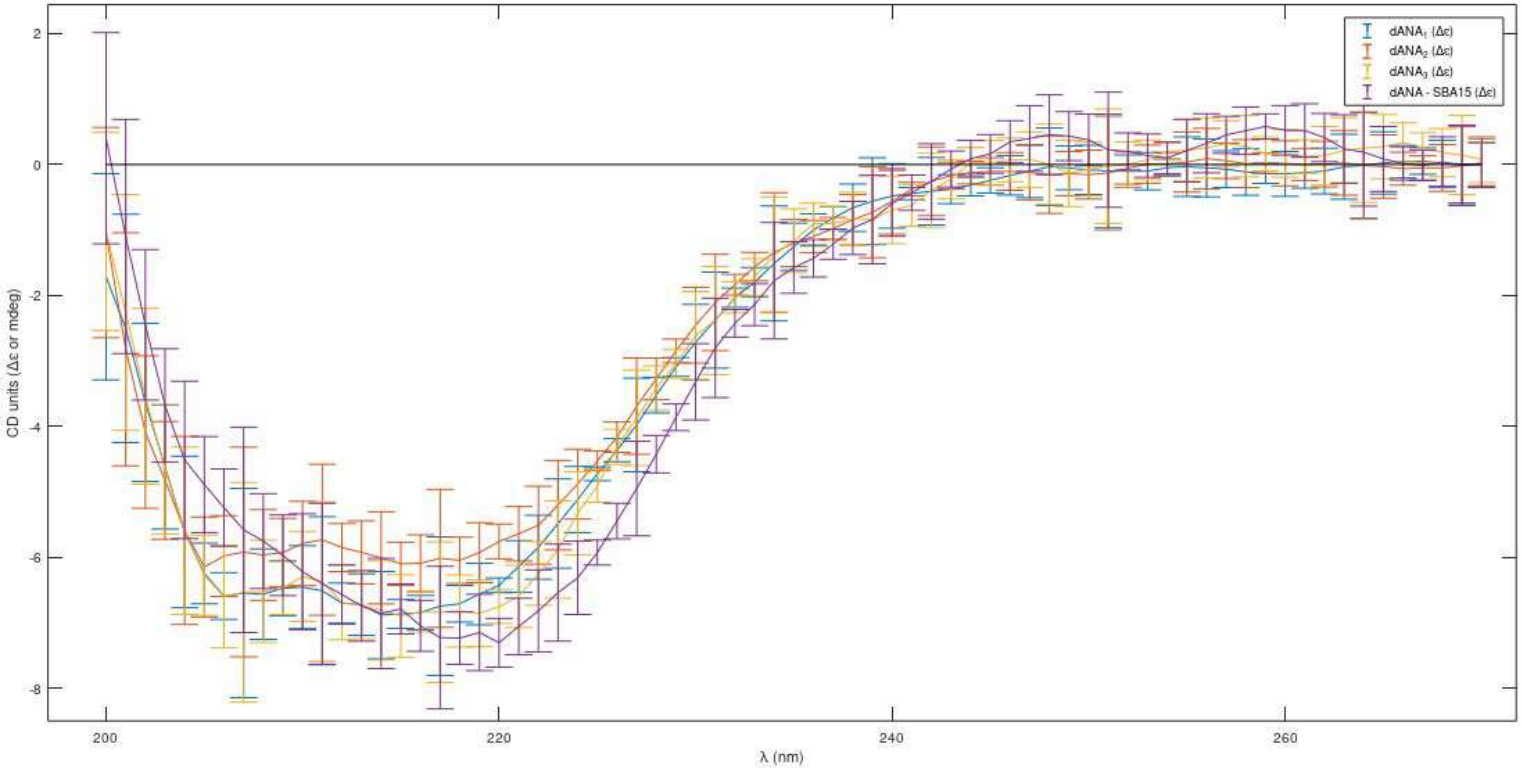


O RISCO DO PH

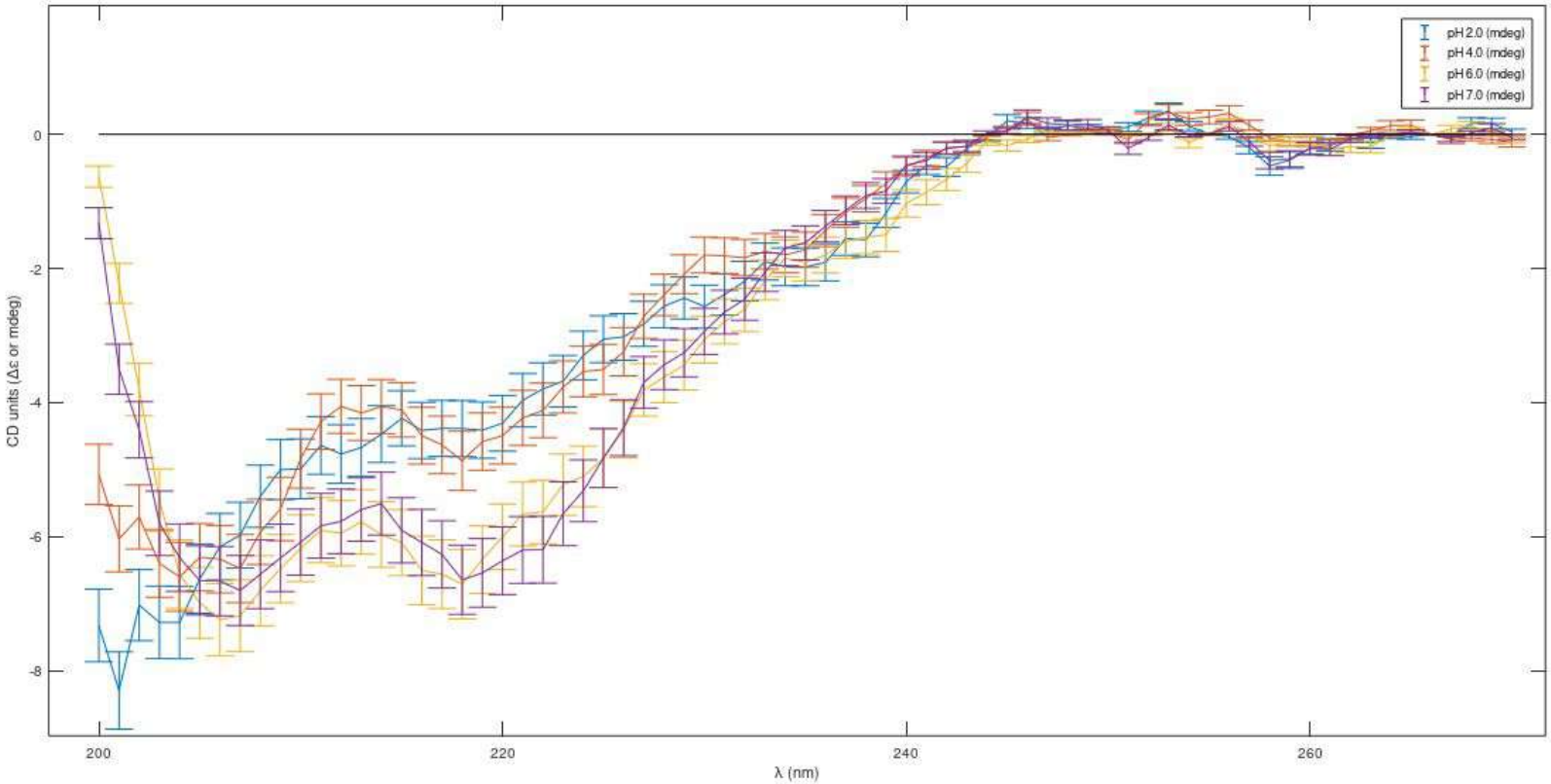

mioglobina pH 2.2 (Δε)
mioglobina (Δε)
CD units (Δε or mdeg)
30
20
10
0
-10
200
220
240
260
280
λ (nm)

Como fica o espectro de CD da Difteria?

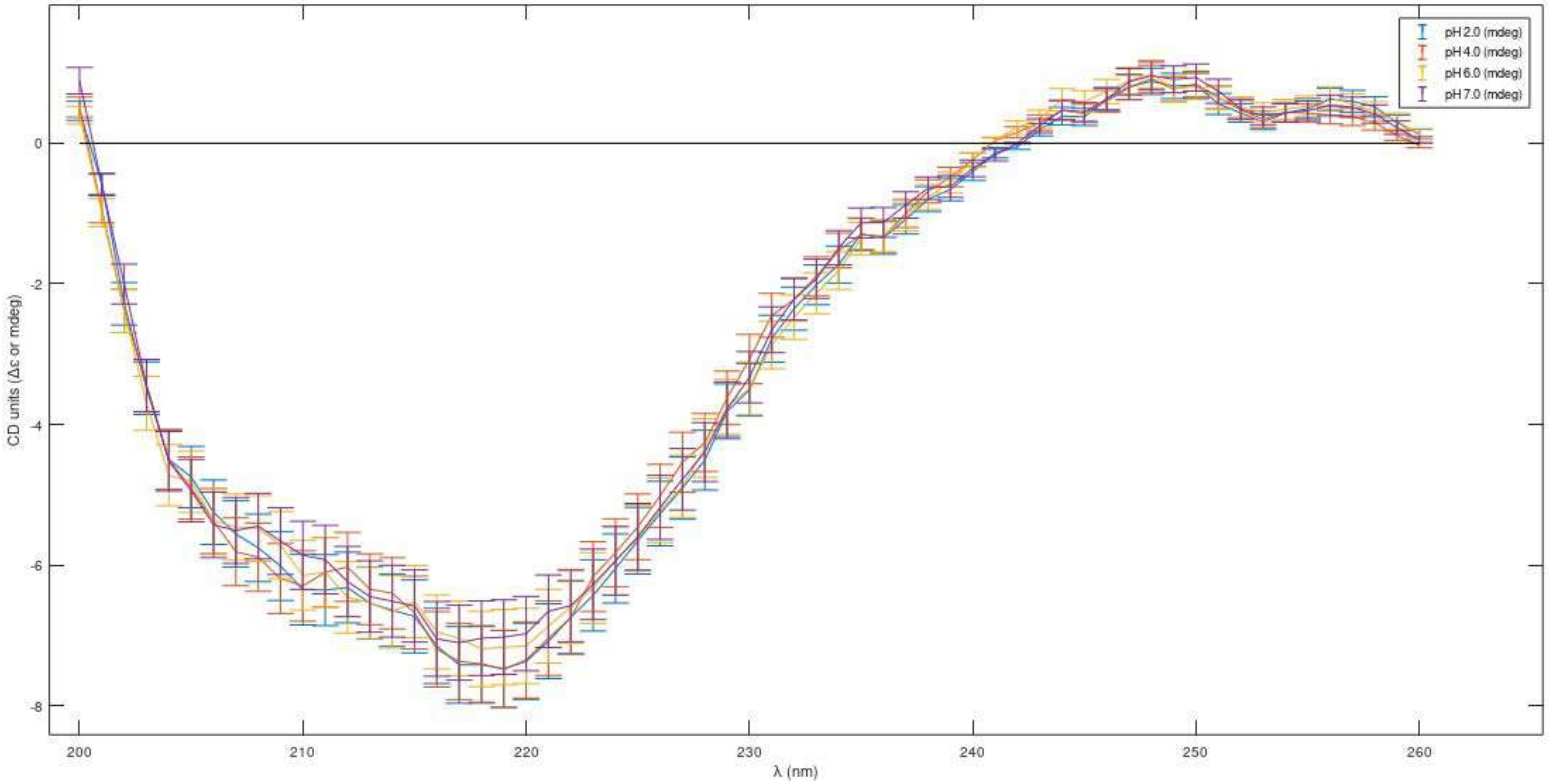
Resultado do CD na dANA



Variação de pH dANA



Variação de pH dANA na SBA-15



Conclusão

VACINAS SALVAM VIDAS

ICTP
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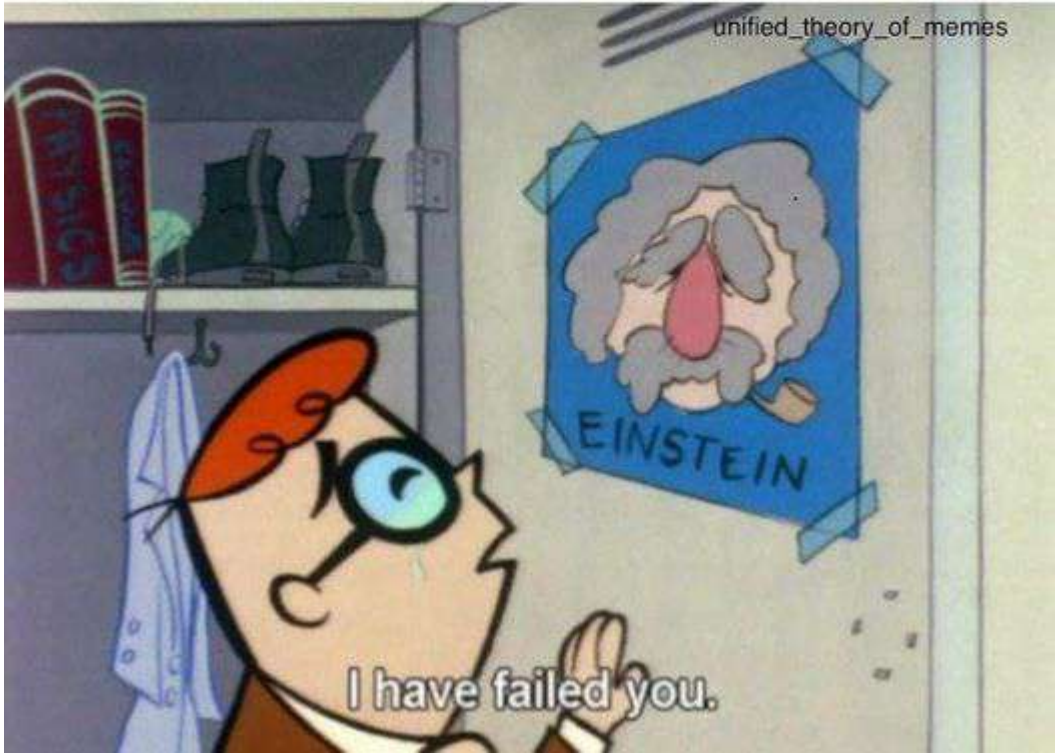
South American Institute
for Fundamental Research

#TODOSPELASVACINAS

Physics students when they actually end up enjoying a science class that isn't physics



Para saber mais:

- Ondas eletromagnéticas <http://gg.gg/ondaseletromagneticas>
- Paper: Microporous and Mesoporous Materials <http://gg.gg/papermateriais>
- Vídeo: O que é biofísica? <http://gg.gg/oqueebiofisica>