

# Formulation of Protein Pharmaceuticals

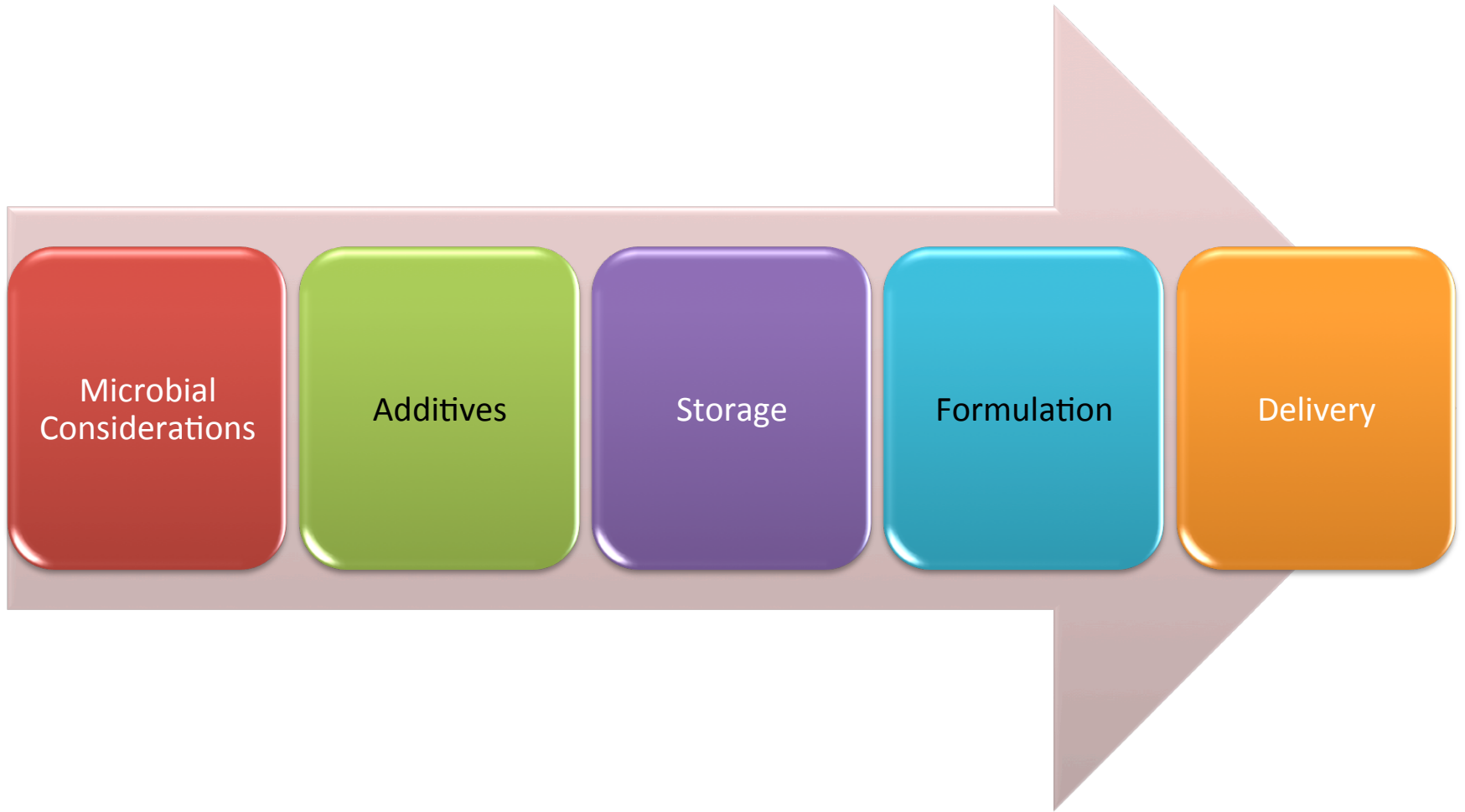
Dr. Aws Alshamsan  
Department of Pharmaceutics  
Office: AA87  
Tel: 4677363  
[aalshamsan@ksu.edu.sa](mailto:aalshamsan@ksu.edu.sa)

# Objectives of the Lecture

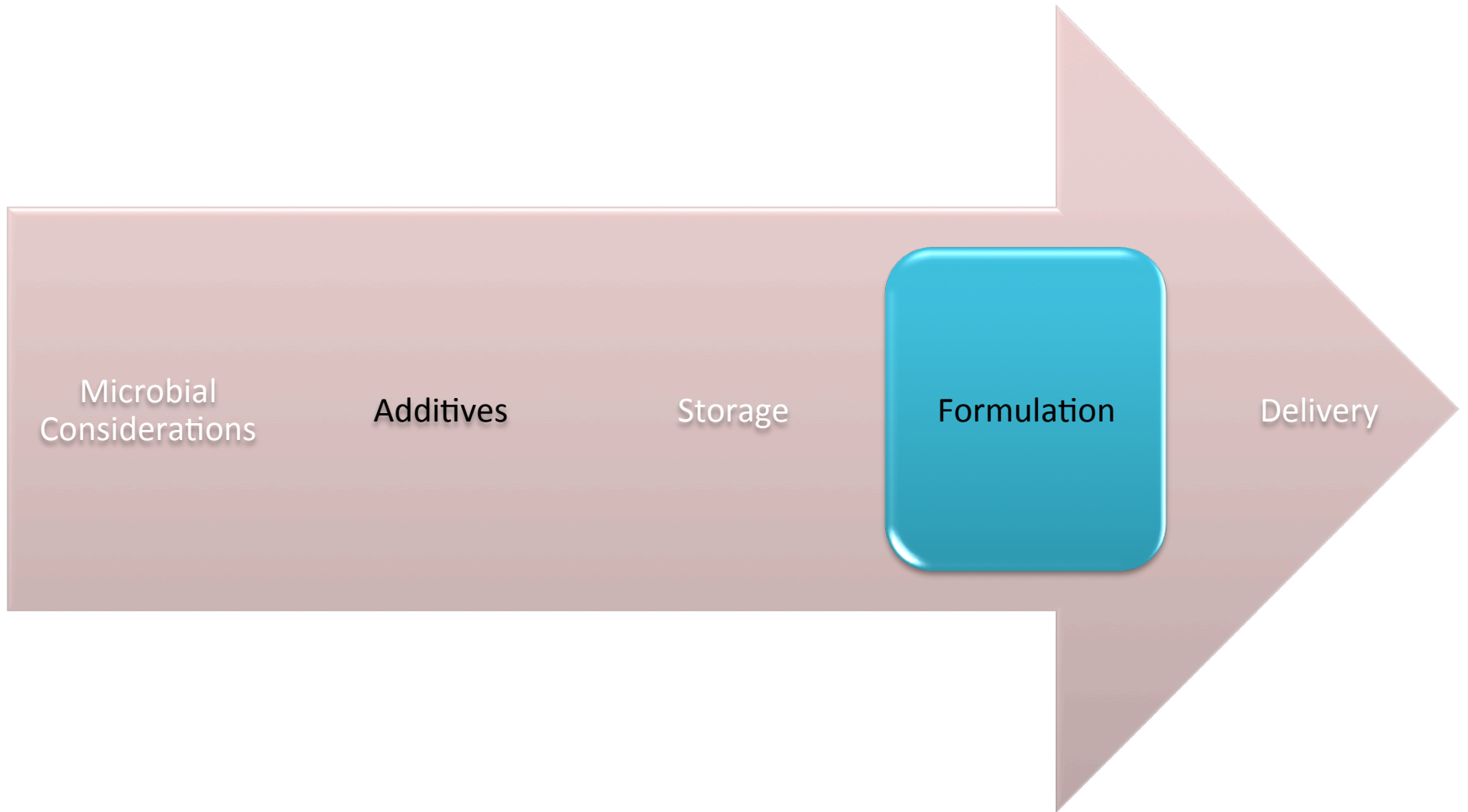
**By the end of this lecture you will be able to:**

1. Describe techniques for optimal protein formulation
2. Realize the importance of delivery systems for protein pharmaceuticals
3. Compare different delivery methods

# Solving the problems



# Solving the problems



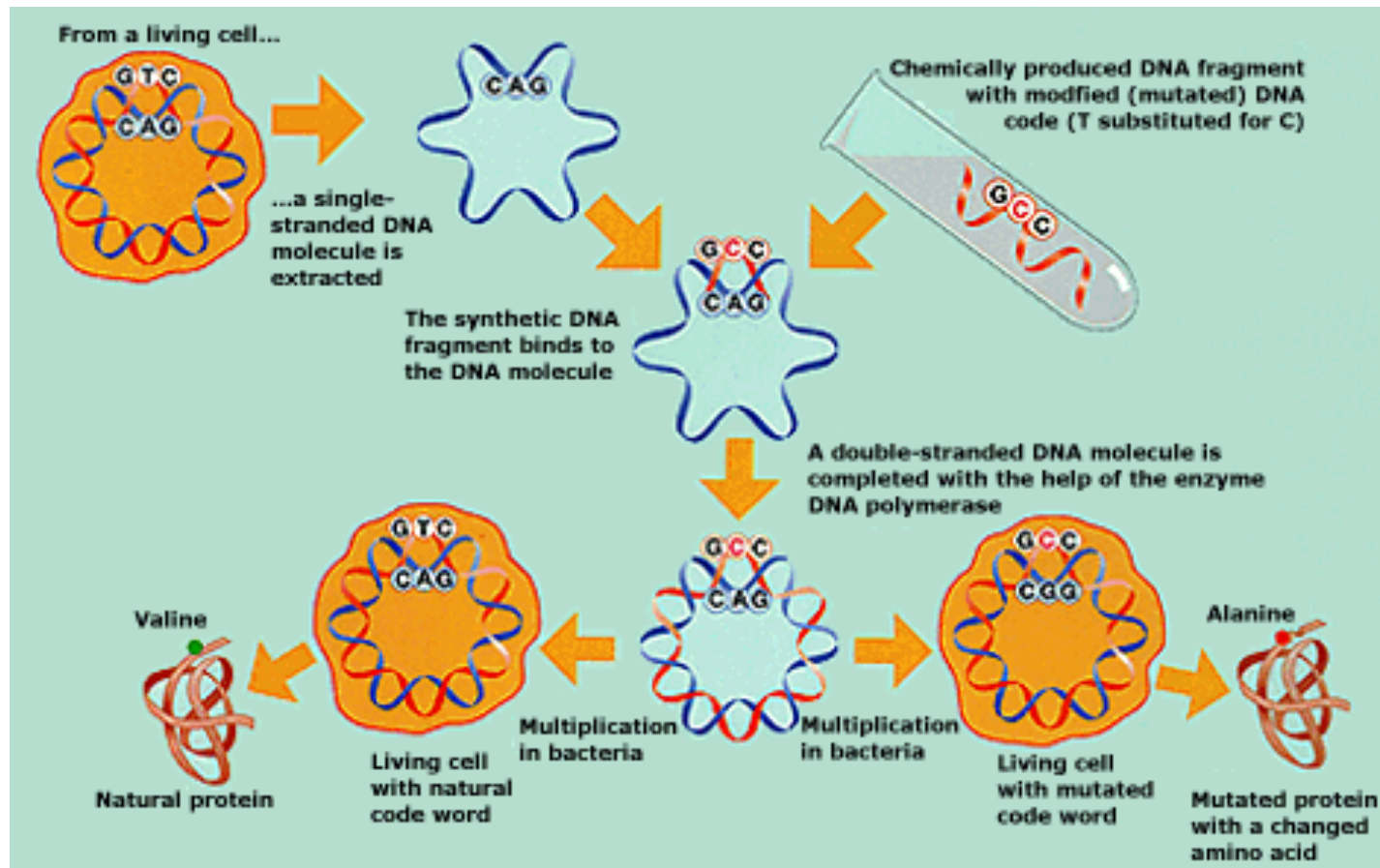
# Formulation

- **Biotechnology products are generally sensitive and have considerably short half-lives as compared to low-molecular weight drugs.**
- **Optimal formulation is supposed to improve the product stability *in vitro* and *in vivo*.**

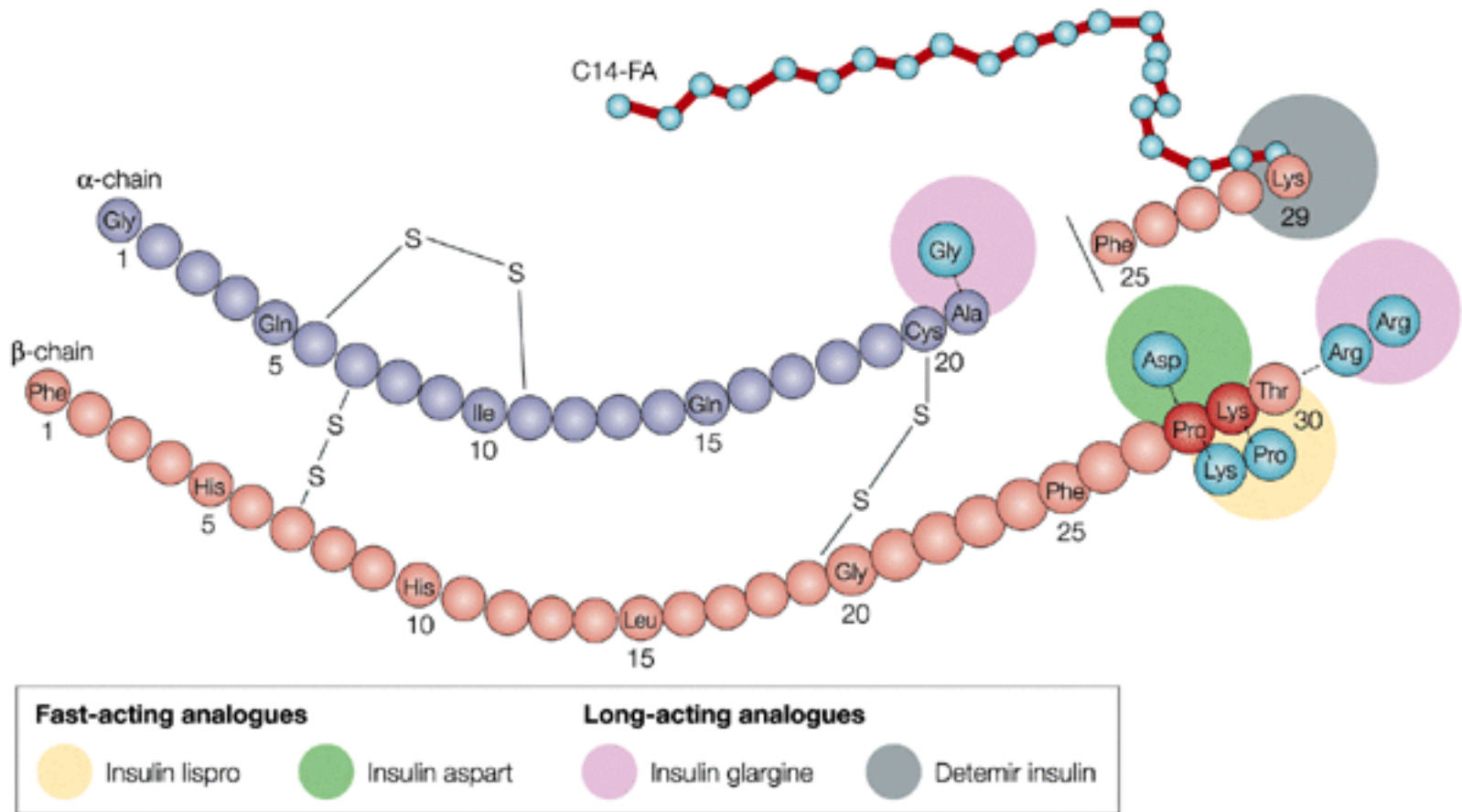
# Site-Directed Mutagenesis

- **Bioengineering process that creates a mutation as a defined site in the DNA strand.**
- **Engineered proteins can be tailored for a specific application or improved stability.**

# Site-Directed Mutagenesis



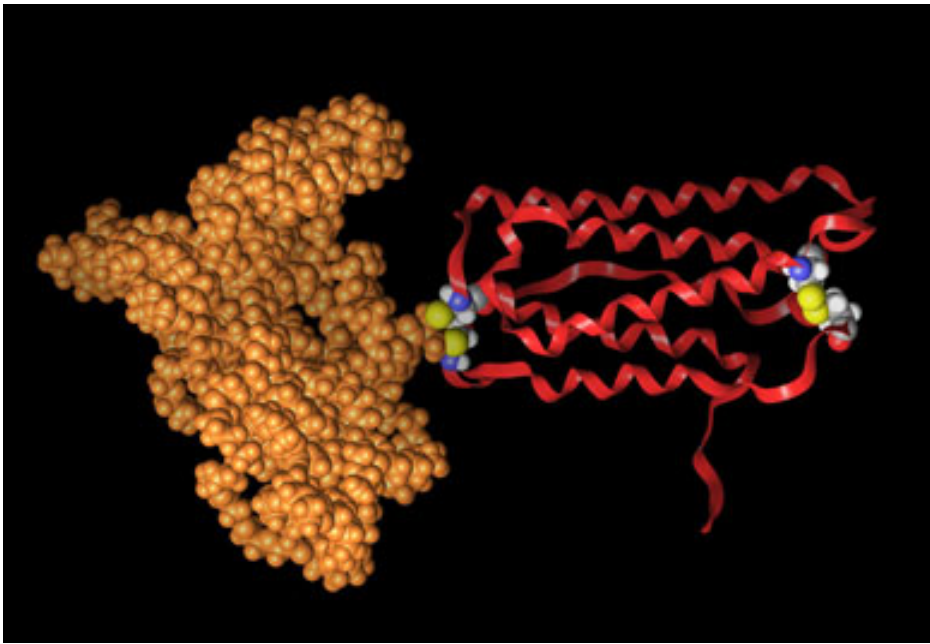
# Site-Directed Mutagenesis



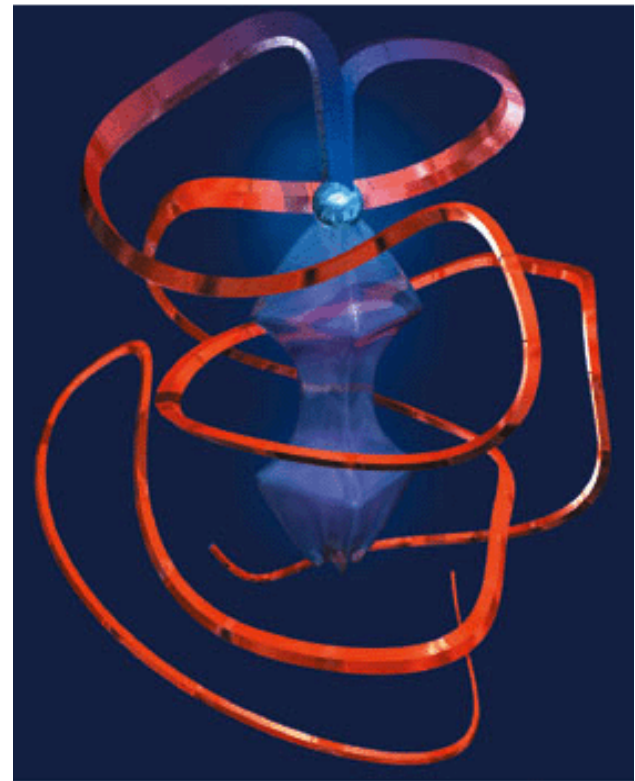


# PEGylation

- Covalent attachment of PEG to another molecule such as protein.



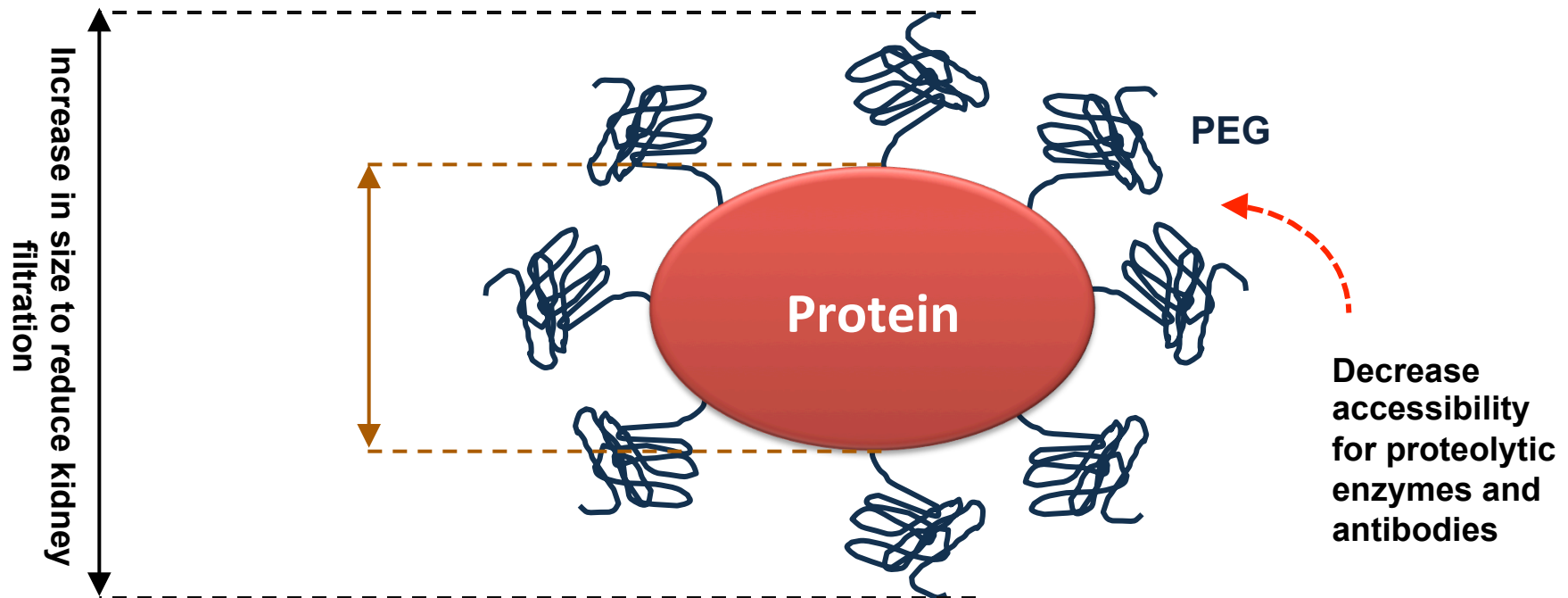
Interferon alfa is surrounded by a PEG chain.



Source: [Hepatitis-care.de](http://Hepatitis-care.de)

# PEGylation

- Significantly increases *in vivo* half life
- Prevents from proteolytic enzymes degradation



# PEGylated proteins in the market

Brand Name	Drug name	Parent Drug	Indication	Approval Year
Adagen®	Pegadamase	Adenosine deaminase	Severe combined immunodeficiency disease (SCID)	1990
Oncaspar®	Pegaspargase	Asparaginase	Leukaemia	1994
PEG-INTRON®	Peginterferon-a2b	IFN-a2B	Hepatitis C	2000
PEGASYS®	Peginterferon-a2a	IFN-a2A	Hepatitis C	2001
Neulasta®	Pegfilgrastim	Granulocyte-colony stimulating factor (GCSF)	Neutropenia	2002
Somavert®	Pegvisomant	Growth Hormone antagonist	Acromegaly	2003
Macugen®	Pegaptanib	Anti-VEGFc aptamer	Age-related macular degeneration	2004
Mircera®	Epoetin beta-methoxy polyethylene glycol	Erythropoietin (EPO)	Anemia associate with Kidney disease	2007
Cimzia®	PEG-Certolizumab pegol	Anti-TNF Fab	Rheumatoid arthritis & Crohn's disease	2008



## **Now you are able to:**

- ✓ Describe techniques for optimal protein formulation
- ✓ Realize the importance of delivery systems for protein pharmaceuticals
- ✓ Compare different delivery methods