# GLYCOPROTEINS

Biochemistry

# Glycoproteins

- **Glycoproteins are proteins that contain oligosaccharide** (glycan) chains covalently attached to their polypeptide backbones.

- Almost all the **plasma proteins** of humans—except albumin—are glycoproteins.
- Many **proteins of cellular membranes** contain substantial amounts of carbohydrate.

- A number of the **blood group substances are glycoproteins.**
- Certain **hormones** (eg, chorionic gonadotropin) are glycoproteins.

- They differ from proteoglycans:

1. Length of the chain is relatively short (usually 2-10 sugar residues) very long in GAGs.
2. Do not have repeating disaccharide units.
3. They are branched.
4. May or may not be negatively charged.

- Glycoproteins occur in most organisms, from bacteria to humans.
- Their carbohydrate content ranges from 1% to over 85% by weight.

- They perform the following functions:

| Function | Example |
| --- | --- |
| Structural role | Collagen |
| Transport role | Transferrin |
| Immunologic role | Immunoglobulins |
| Cell-to-cell communication | Selectins |
| | Proteins in fertilization |
| | Cell adhesion molecules |
| Cell signalling | Many receptors |
| Clotting | Plasma proteins |
| | Lipoproteins |
| Lubrication | Mucins |

| | |
|---|---|
| Hormones | HCG, TSH |
| Anti freeze | cold water fish |

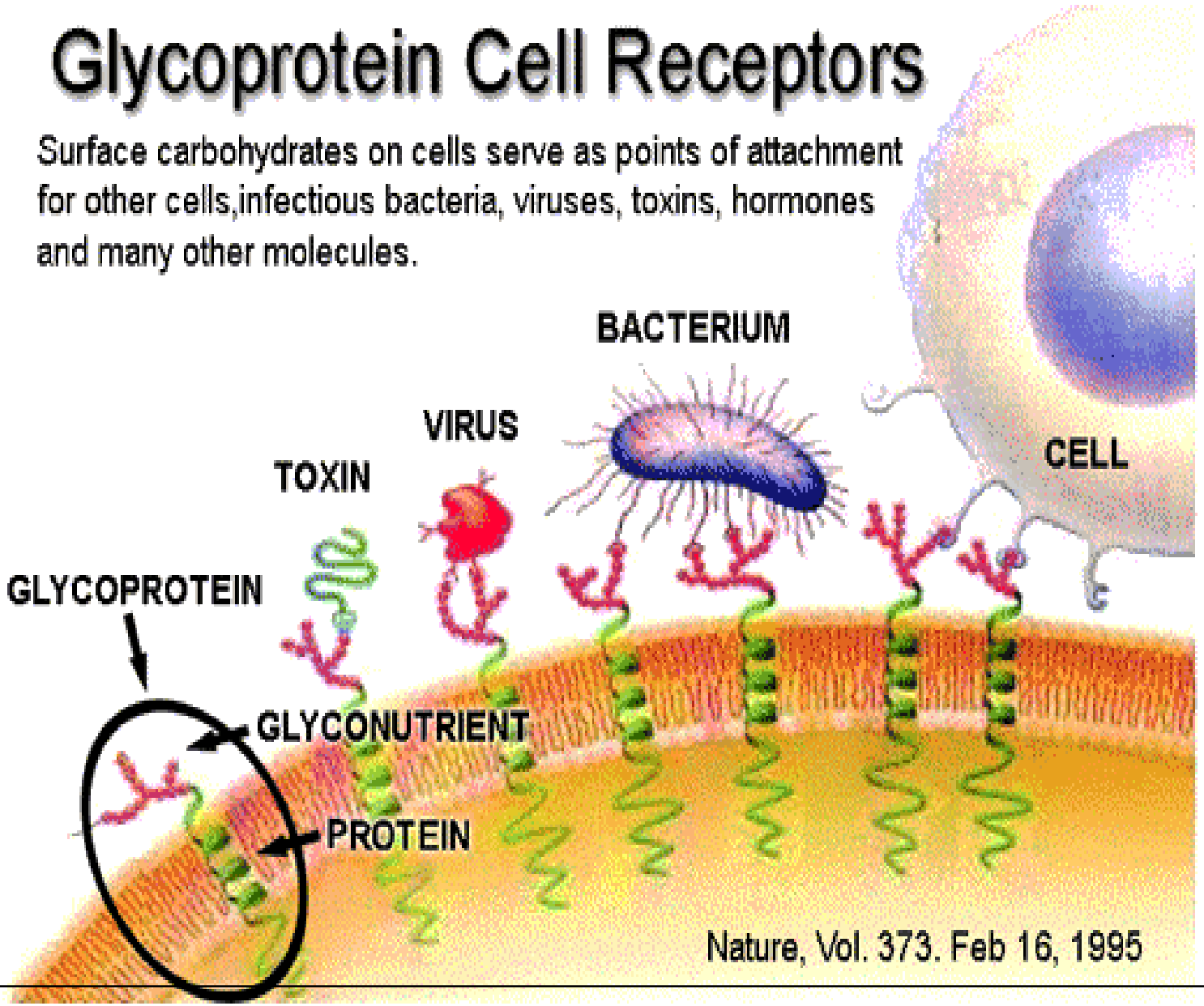
## Some of the processes involving glycoproteins:

- inflammation
- blood clotting
- peptic ulcers
- AIDS (HIV)

- influenza
- fertilization
- cancer
- cystic fibrosis
- arthritis

# Glycoprotein Cell Receptors

Surface carbohydrates on cells serve as points of attachment for other cells,infectious bacteria, viruses, toxins, hormones and many other molecules.



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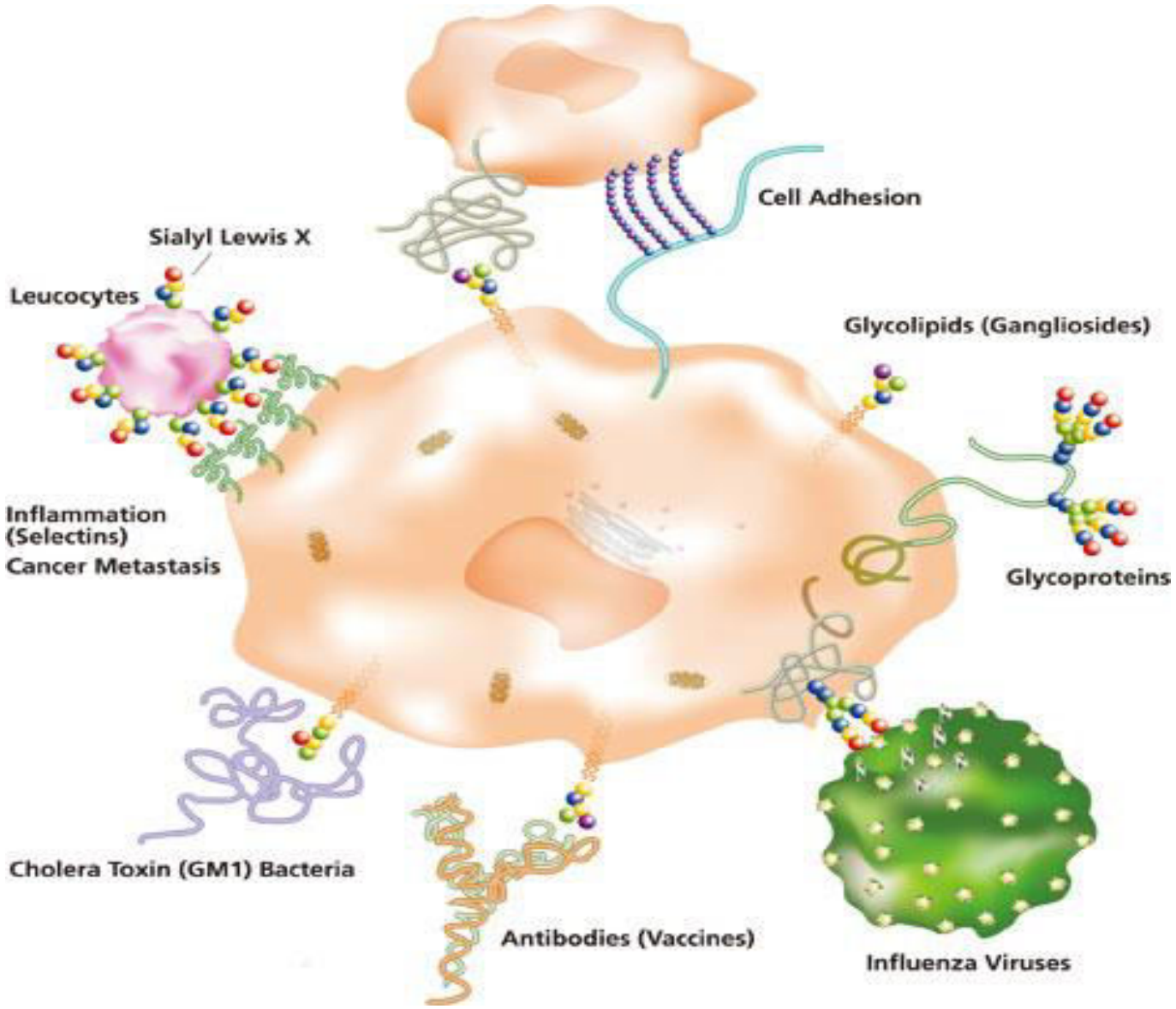


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- The predominant sugars found in glycoproteins are:
- glucose (Glc),
- galactose (Gal),
- mannose (Man),
- fucose (Fuc),

- *N*-acetylgalactosamine (GalNAc),
- *N*-acetylglucosamine (GlcNAc)
- and *N*-acetylneuraminic acid (NANA). NANA is also called sialic acid.

- The distinction between **proteoglycans** and **glycoproteins** resides in the level and types of carbohydrate modification.

- Proteoglycans also contain the sugar **glucuronic acid** (GlcA).
- The carbohydrate modifications found in glycoproteins are rarely as complex as that of proteoglycans.

- The carbohydrates of glycoproteins are linked to the protein component through either ***O*-glycosidic** or ***N*-glycosidic** bonds.

- The ***N*-glycosidic** linkage is through the amide group of asparagine (Asn, N).

- The ***O*-glycosidic** linkage is to the hydroxyl of serine (Ser, S), threonine (Thr, T) or hydroxylysine (hLys).

## O-linked sugars:

- May be membrane glycoprotein components
- Or extracellular glycoproteins.

- When attached to Ser or Thr, the sugar of *O*-linked glycoproteins is most often GalNAc.

- ***N*-linked sugars:** The predominant carbohydrate attachment in glycoproteins of mammalian cells is via *N*-glycosidic linkage.

They are of two types:

1. Complex oligosaccharides
2. High mannose oligosaccharides

- Their core pentasaccharide is the same.

- In the complex form additional sugar residues are present:

*N*-acetylglucosamine (GlcNAc)

and *N*-acetylneuraminic acid (NANA).

Fucose

- High mannose contain only mannose residues

- Most proteins that are secreted, or bound to the plasma membrane, are modified by carbohydrate attachment.

- The part that is modified, in plasma membrane-bound proteins, is the extracellular portion of the protein.

- Intracellular proteins are less frequently modified by carbohydrate attachment. However, the attachment of carbohydrate to intracellular proteins confers unique functional activities on these proteins

- I – cell disease
- Cancers
- Metastasis