1.Carbohydrate

- Carbohydrates- (**hydrated carbon**) are important organic compounds that include sugars, starch, cellulose and polymers that are mostly linked to proteins.
- Carbohydrates are defined chemically as ketone or aldehyde derivatives of polyhydroxy alcohols and they may be classified as monosaccharides (mono 1 saccharide: sugar unit.) oligo: few, 2:10) or polysaccharides: (poly: many)
- Glucose- is the **only monosaccharide found in the body** in any **demonstrable quantity**. Glucose is extremely soluble in aqueous solution and has a small molecular size it cannot be demonstrated in tissue sections.
- Mucosubstances - Collective term that includes polysaccharides, glycoproteins and proteoglycans.

- Glycogen – a polymer of glucose is the form in which carbohydrates are stored in humans in the liver and skeletal muscles. **When the cells need energy** the **stored glycogen is readily broken down by the body into glucose**.
- Because this enzymatic breakdown may also occur after death, if autopsy tissues are the source for glycogen demonstration, prompt fixation has to be done.
- Glycogen is relatively insoluble in aqueous solution so it can be demonstrated in tissue sections.

Group 1-Neutral Polysaccharides(nonionic homoglycans)

- 1. Glucose – containing: glycogen, starch, cellulose.
- 2. N – acetyl- glucosamine – containing chitin.
- This group gives a vey positive PAS reaction and a negative reaction with other carbohydrate stains (alcian blue, colloidal iron, mucicarmine)

Group II: Acid Mucopolysaccharides (anionic heteroglycans)

- 1. Carboxylated (COOH) : hyaluronic acid, found in connective tissues and umbilical cord.
- 2. Sulfated (OSOH) and carboxylated (COOH)
- Chondroitin sulfate A (chondroitin-4-sulfate)
- Chondroitin sulfate C (chondroitin-6-sulfate), found in cartilage, chondrosarcomas, cornea, and blood vessels
- Chondroitin sulfate B (dermatan sulfate) found mainly in skin, also in connective , aorta, and lung
- Sulfated only (COOH - free): human aorta and bovine cornea.
- All polysaccharides in this group are acidic (anionic) are PAS negative, but stain with alcian blue, colloidal iron and mucicarmine.

Group III- Glycoproteins (mucins, mucoproteins, mucosubstances

- 1. Neutral : ovimucoid (egg white) mucin in stomach, Paneth cell granules
- 2. Carboxylated (COOH) sialoglycoproteins that contain sialic acid but no sulfate
- Sialomucins found in submaxillary gland mucin, small intestine mucins, fetal mucins, the upper part of colonic crypts, and human sublingual gland
- Serum glycoproteins
- Blood group substances
- 3. Sulfated and carboxylated: sialoglycoproteins- both sialic acid and sulfate in sheep and humans mucin
- Potentially but not necessarily PAS positive

GroupIV: Glycolipids

- 1 Cerebrosides: fatty residue bound to a carbohydrate structure
- 2. Phosphatides: PAS positive, noncarbohydrate – containing lipids including lecithin, cephalin and sphingomyelin.

Histochemistry- Special Staining Techniques

- PAS (Periodic Acid Schiff) reagent is prepared by treating basic fuschin (pararosaniline) with sulfurous acid. Reduction cause the loss of the quinoid structure and masking of the chromophores. A colorless compound often referred to as leucofuschin, is formed. Following the Schiff reaction, wash in running water causes the loss of bound sulfurous acid group. Mrtabisulfite rinses remove excess Schiff reagent and prevent false coloring of tissue elements because of oxidation of any absorbed reagent.
- Quality Control
- A section of kidney is most sensitive control.
- See page 137-139

Test for Quality of Schiff Reagent

- Place 10 ml of 37% to 40 % formaldehyde in a beaker or flask.
- Add a few drops of Schiff reagent.
- If the solution rapidly turns reddish purple, it is good.
- If the reaction delayed and the resultant color is a deep blue-purple, the solution is breaking down.