- maltose is a disaccharide formed by condensation of two glucose molecules
- sucrose is a disaccharide formed by condensation of a glucose molecule and a fructose molecule
- lactose is a disaccharide formed by condensation of a glucose molecule and a galactose molecule.

Glucose has two isomers, α-glucose and β-glucose, with structures:

Polysaccharides are formed by the condensation of many glucose units.

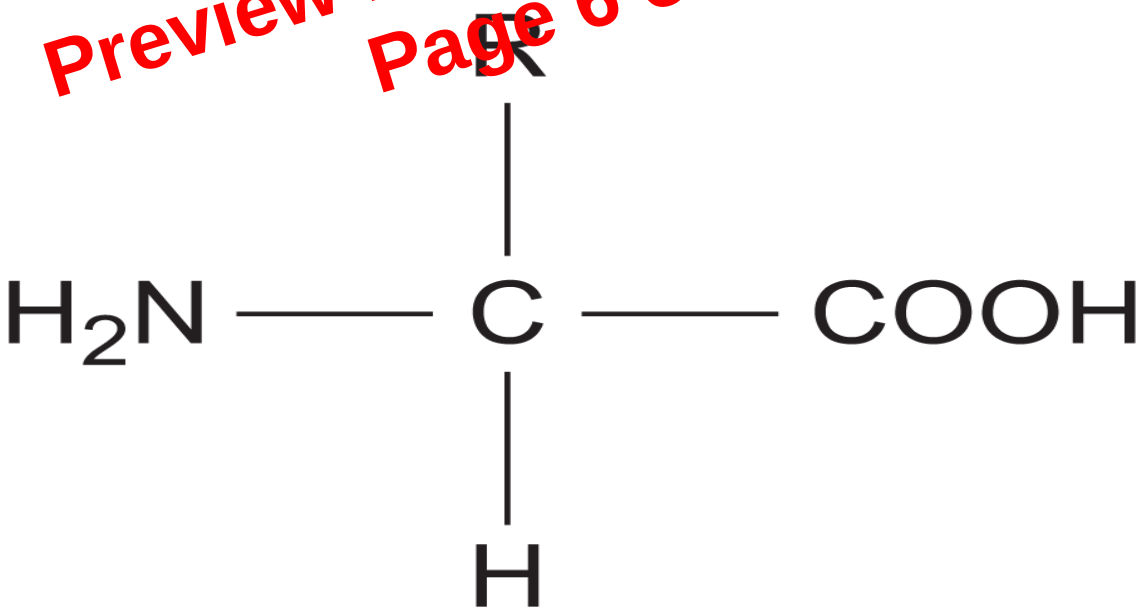
- Glycogen and starch are formed by the condensation of α-glucose.

- recognise, from diagrams, saturated and unsaturated fatty acids
- explain the different properties of triglycerides and phospholipids.

4.Proteins

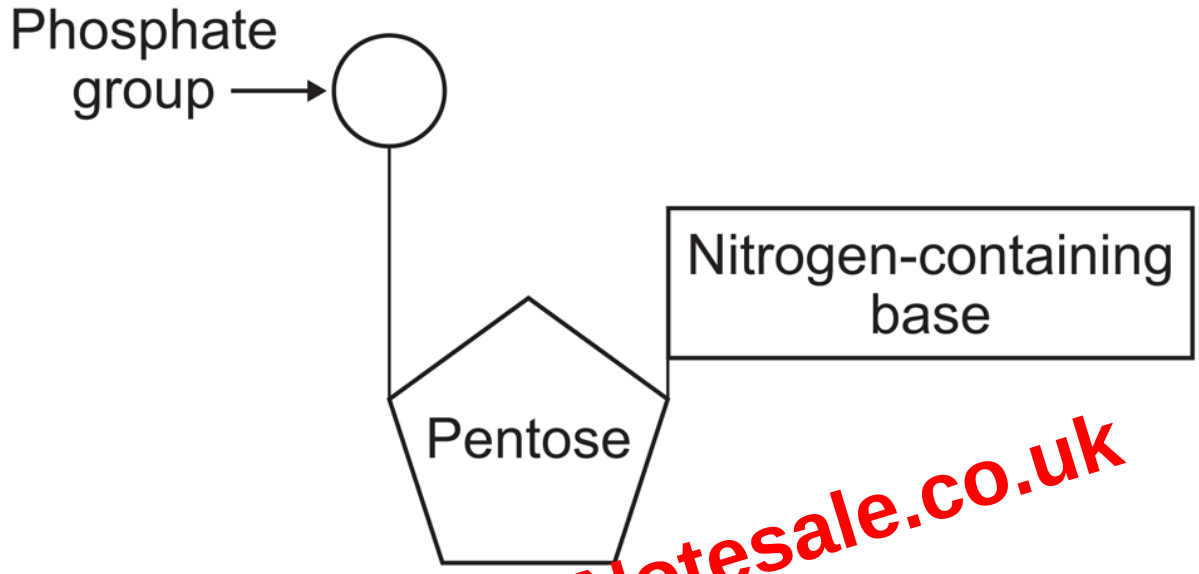
4.1 General Properties of proteins

Amino acids are the monomers from which proteins are made.



The general structure of an amino acid as:

Both DNA and RNA are polymers of nucleotides. Each nucleotide is formed from a pentose, a nitrogen-containing organic base and a phosphate group:



- The components of a DNA nucleotide are deoxyribose, a phosphate group and one of the organic bases adenine, cytosine, guanine or thymine.
- The components of an RNA nucleotide are ribose, a phosphate group and one of the organic bases adenine, cytosine, guanine or uracil.
- A condensation reaction between two nucleotides forms a phosphodiester bond.

A DNA molecule is a double helix with two polynucleotide chains held together by hydrogen bonds between specific complementary base pairs.

An RNA molecule is a relatively short polynucleotide chain.

- smaller ribosomes
- no nucleus; instead they have a single circular DNA molecule that is free in the cytoplasm and is not associated with proteins
- a cell wall that contains murein, a glycoprotein.

In addition, many prokaryotic cells have:

- one or more plasmids
- a capsule surrounding the cell
- one or more flagella.

Details of these structural differences are **not** required.

Viruses are acellular and non-living. The structure of virus particles to include genetic material, capsid and attachment protein.

3.Methods of studying cells

The principles and limitations of optical microscopes, transmission electron microscopes and scanning electron microscopes.

Measuring the size of an object viewed with an optical microscope. The difference between magnification and resolution.

Use of the formula:

Principles of cell fractionation and ultracentrifugation as used to separate cell components.

Deformation of stretch-mediated sodium ion channels in a Pacinian corpuscle leads to the establishment of a generator potential.

The human retina in sufficient detail to show how differences in sensitivity to light, sensitivity to colour and visual acuity are explained by differences in the optical pigments of rods and cones and the connections rods and cones make in the optic nerve.

3.Control of heart rate

Myogenic stimulation of the heart and transmission of a subsequent wave of electrical activity. The roles of the sinoatrial node (SAN), atrioventricular node (AVN) and Purkyne tissue in the bundle of His.

The roles and locations of chemoreceptors and pressure receptors and the roles of the autonomic nervous system and effectors in controlling heart rate.

Nervous coordination

4.Nerve impulses

The structure of a myelinated motor neurone.

The establishment of a resting potential in terms of differential membrane permeability, electrochemical gradients and the movement of sodium ions and potassium ions.

Changes in membrane permeability lead to depolarisation and the generation of an action potential. The all-or-nothing principle.

The second messenger model of adrenaline and glucagon action, involving adenylate cyclase, cyclic AMP (cAMP) and protein kinase.

The causes of types I and II diabetes and their control by insulin and/or manipulation of the diet.

Students should be able to evaluate the positions of health advisers and the food industry in relation to the increased incidence of type II diabetes.

9.Control of blood water potential

Osmoregulation as control of the water potential of the blood.

The roles of the hypothalamus, posterior pituitary and antidiuretic hormone (ADH) in osmoregulation.

The structure of the nephron and its role in:

- the formation of glomerular filtrate
- reabsorption of glucose and water by the proximal convoluted tubule
- maintaining a gradient of sodium ions in the medulla by the loop of Henle
- reabsorption of water by the distal convoluted tubule and collecting ducts.

Students should be able to:

- show understanding of the need to manage the conflict between human needs and conservation in order to maintain the sustainability of natural resources
- evaluate evidence and data concerning issues relating to the conservation of species and habitats and consider conflicting evidence
- use given data to calculate the size of a population estimated using the mark-release-recapture method.

1.Alteration of the sequence of bases in DNA can alter the structure of proteins

Gene mutations might arise during DNA replication. They include addition, deletion, substitution, inversion, duplication and translocation of bases.

Gene mutations occur spontaneously. The mutation rate is increased by mutagenic agents. Mutations can result in a different amino acid sequence in the encoded polypeptide.

- Some gene mutations change only one triplet code. Due to the degenerate nature of the genetic code, not all such mutations result in a change to the encoded amino acid.
- Some gene mutations change the nature of all base triplets downstream from the mutation, ie result in a frame shift.

Students should be able to relate the nature of a gene mutation to its effect on the encoded polypeptide.

Epigenetics involves heritable changes in gene function, without changes to the base sequence of DNA. These changes are caused by changes in the environment that inhibit transcription by:

- increased methylation of the DNA or
- decreased acetylation of associated histones.

The relevance of epigenetics on the development and treatment of disease, especially cancer.

In eukaryotes and some prokaryotes, translation of the mRNA produced from target genes can be inhibited by RNA interference (RNAi).

Students should be able to:

- interpret data provided from investigations into gene expression
- evaluate appropriate data for the relative influences of genetic and environmental factors on phenotype.

4.Gene expression and cancer

The main characteristics of benign and malignant tumours.

The role of the following in the development of tumours:

- tumour suppressor genes and oncogenes
- abnormal methylation of tumour suppressor genes and oncogenes
- increased oestrogen concentrations in the development of some breast cancers.