

Solutions

2.1 Any two: sexual needs two parents/gametes, asexual one; sexual gives genetically different offspring, asexual gives identical clones; sexual involves meiosis and fertilisation, asexual only mitosis.

2.2 Four gametes; each is genetically different from the others.

2.3 Search for genes linked to different diseases; understanding and treatment of inherited disorders; tracing human migration patterns from the past.

3.1 Seeds are produced by sexual reproduction – gametes from two parents fuse, so offspring show genetic variation; variation gives a survival advantage if the environment changes, e.g. new disease or drought. Runners are asexual – mitosis only, so the new plants are genetically identical clones of the parent; this is an advantage when conditions are favourable, because many identical, well-adapted offspring grow quickly, without needing a mate.

3.2 DNA is a polymer made of two strands coiled into a double helix; each nucleotide has a common sugar and phosphate group with one of four bases – A, C, G or T – attached to the sugar; the backbone alternates sugar and phosphate; a sequence of three bases codes for one amino acid; the order of the bases controls the order of amino acids assembled into the protein.

3.3 A mutation changes the base sequence of the gene; a different amino-acid sequence is assembled, so the protein's shape changes when it folds; an altered enzyme may no longer fit the substrate binding site, so its reaction stops; the phenotype changes because the protein no longer works – or only slightly, since most mutations have no effect. Non-coding DNA variants may instead switch the gene on or off, changing expression.