• Cells are smaller than white adipose but cytoplasm has more lipid droplets of varying size
• Spherical and central nuclei, mitochondria have elongated cristae
• Tissue subdivided by connective tissue into lobules
• Receive direct SNS innervation

**Function of brown adipocytes**

• Main function is heat production by non-shivering thermogenesis
• More abundant in hibernating animals
• Sympathetic nervous system (SNS) stimulation releases noradrenaline to brown adipose – activates hormone-sensitive lipase promoting TAG hydrolysis
  o However, FFAs metabolised quicker than white fat, increasing oxygen consumption and heat production
  o Increases temperature and warms blood passing through it
• Heat production increased in brown adipose as the mitochondria have a transmembrane protein called thermogenin/uncoupling protein I (UCP-1) in the inner cell membrane
• Thermogenin permits backflow of proteins from the intermembrane space into the mitochondrial matrix without passing through ATP-synthase
  o Thus not used to synthesise ATP and is dissipated as heat
• SNS stimulation also increases differentiation and inhibits apoptosis

**Histogenesis of brown adipose**

• Also develops from embryonic mesenchyme, emerges earlier than white fat during embryonic development
• Mesenchymal cells and lipoblasts resemble epithelium before accumulating much fat
• Brown fat mostly restricted to new-born, when non-shivering thermogenesis most needed
• Tissue largely disappears or converts to white fat with age; only in scattered areas in adult (kidneys, adrenals, aorta, mediastinum)
• Number of adipocytes increased during cold adaptation – usually appears as clusters within white adipose
  o Likely differentiation of mesenchymal stem cells

**Clinical note**

• Common benign tumours can form from unilocular adipocytes (lipomas)
• Malignant tumours originating from adipocytes (liposarcomas) are rare