- 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
    - However, FFAs metabolised quicker than white fat, increasing oxygen consumption and heat production
    - 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
    - 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
    - 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