

Y is for Yellow adipose

A-Z of Staining - a series of articles where we share a little extra information about stains, staining techniques and some of the interesting chemicals associated.



Welcome to the ABC of Staining where we continue with 'Y' for Yellow adipose tissue.

Yellow adipose is a term that is used for both yellow bone marrow and white adipose tissue which appears yellow due to the presence of dietary carotene deposited in the fat cells. The main functions of yellow adipose tissue are as an energy store and a thermal insulator for maintaining body temperature. This tissue can also be a marker for yellow fat disease (steatitis) which can result from a lack of antioxidants such as vitamin E.

Yellow bone marrow is the fatty tissue that is found in the cavities of long bones such as the femur. The tissue consists mainly of adipocytes (which gives the marrow its yellow hue) and also contains connective tissue and mesenchymal stem cells. Although it is the red bone marrow that converts to yellow as the body matures, in certain medical circumstances, the yellow bone marrow can convert back to red marrow. In addition, yellow bone marrow has other active roles such as in the formation of blood cells and the remodelling of bone. The differences between yellow and red bone marrow are most apparent when comparing their functions and composition (see Table below).

	Yellow Bone Marrow	Red Bone Marrow
Primary Function	Fat storage	Production of blood cells
Primary Location	Central cavities of long bones	Spongy (cancellous) sections of flat bones and the ends of long bones
Composition	Mostly fat and mesenchymal stem cells	Haematopoietic stem cells, blood cells, and a rich network of blood vessels
Appearance	Yellow due to a high concentration of fat cells	Red due to a rich blood supply and developing blood cells
Development Stage	Predominates in adults as the need for blood cell production declines	Found throughout the skeleton in infants and young children
Reversibility	Can be converted to red marrow in emergencies, such as severe blood loss	Does not convert to yellow marrow as readily or extensively

Histological investigation on bone marrow samples is usually carried out following aspiration or biopsy. Bone marrow aspiration uses a hollow needle to remove a small volume of liquid bone marrow which can then be examined in the laboratory. A bone marrow biopsy uses a different type of needle that removes a solid core of bone tissue that can be fixed and processed routinely. Sections of yellow bone marrow (and adipose tissue) is generally stained using haematoxylin and eosin (H&E). The presence of fat-storing adipocytes are emphasized as clear, vacuuous spaces as a consequence of the fat having been dissolved out in the solvents used during tissue processing (Figure 1). However, if frozen sections of fresh tissue are used, the fat is preserved and can be stained using fat-soluble dyes such as Oil Red O and Sudan Black B (Figure 2).

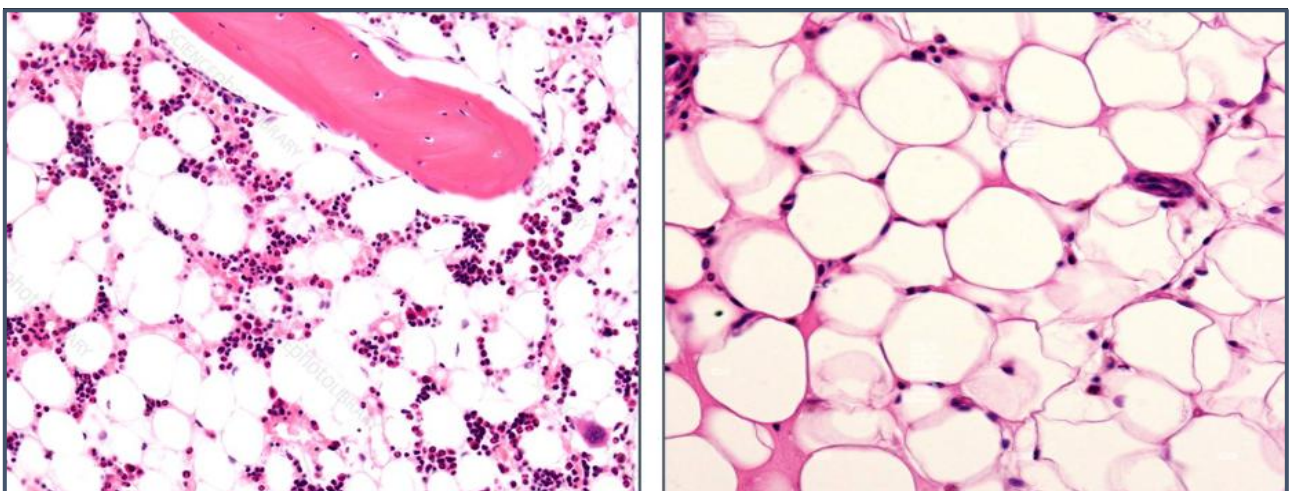


Figure 1. Yellow bone marrow (left) and adipose tissue (right) stained with H&E

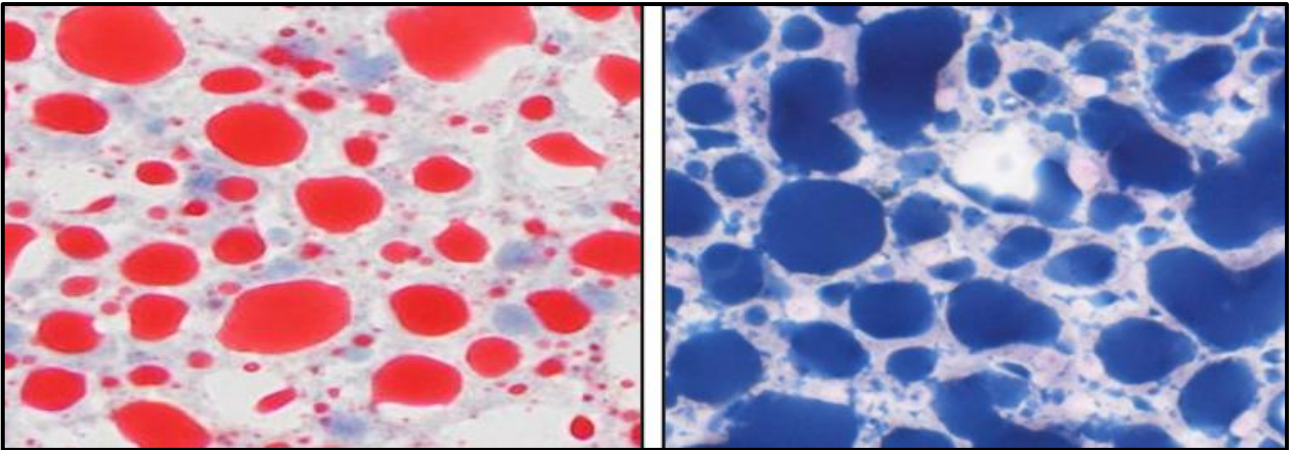


Figure 2. Frozen sections of fat stained with Oil Red O (left) and Sudan Black B (right image)

For bone marrow histology, the presence of surrounding bone makes sectioning difficult without prior decalcification. Following this process, other stains are often used in conjunction with or instead of the H&E stain. Methods such as van Gieson which stains collagen red and adipocytes yellow, and silver impregnation which demonstrates the reticulin network as black fibres help to highlight parts of the connective tissue framework that supports the adipocytes (Figure 3). Frozen section analysis of the bone marrow is technically challenging due to the high fat and bony content which makes freezing and cutting the tissues difficult.

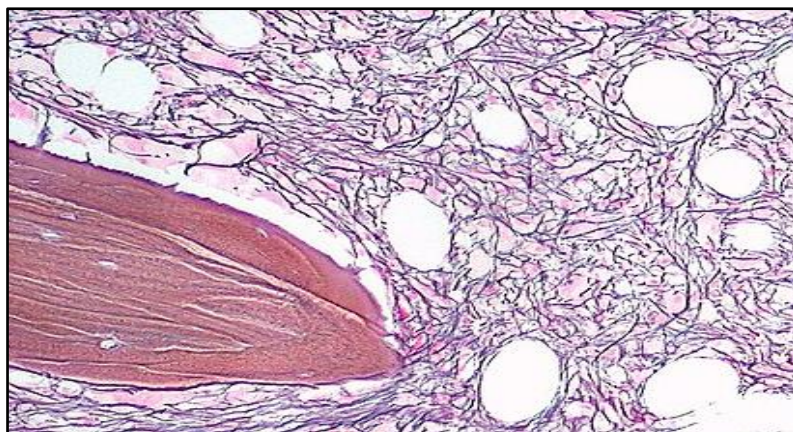


Figure 3. Black reticular fibres in a bone marrow biopsy

Further reading

Busilacchi et al (2024). Bone marrow adipose tissue. *Cells* 2024;13(9):724.
doi: [10.3390/cells13090724](https://doi.org/10.3390/cells13090724)

Lopez-Yus et al (2024). Unravelling adipose tissue dysfunction: Molecular mechanisms, novel biomarkers, and therapeutic targets for liver fat deposition. Cells 2024;13(5):380. doi: [10.3390/cells13050380](https://doi.org/10.3390/cells13050380)

Schimanski et al (2025). Histology and immunochemistry of adipose tissue: A scoping review on staining methods and their informative value. Cells 2025;14(12):898. doi: [10.3390/cells14120898](https://doi.org/10.3390/cells14120898)

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