Types of proteins present in Intermediate

Filaments of Cytoskeleton

There are about 70 different human genes coding for various intermediate filament proteins. However, different kinds of IFs share basic characteristics: In general, they are all polymers that measure between 9-11 nm in diameter when fully assembled.

Animal IFs are subcategorized into six types based on similarities in amino acid sequence and [protein](https://en.wikipedia.org/wiki/Protein) structure:[[6]](https://en.wikipedia.org/wiki/Intermediate_filament#cite_note-interfil-6)

**Types I and II – acidic and basic keratin**



[Keratin](https://en.wikipedia.org/wiki/Keratin) intermediate filaments (stained red) around [epithelial cells](https://en.wikipedia.org/wiki/Epithelium).

These proteins are the most diverse among IFs and constitute [type I (acidic)](https://en.wikipedia.org/wiki/Type_I_cytokeratin) and [type II (basic)](https://en.wikipedia.org/wiki/Type_II_cytokeratin) IF proteins. The many [isoforms](https://en.wikipedia.org/wiki/Isoform) are divided in two groups:

* **epithelial keratins** (about 20) in [epithelial](https://en.wikipedia.org/wiki/Epithelial) cells (image to right)
* **trichocytic keratins** (about 13) ([hair keratins](https://en.wikipedia.org/wiki/Hair_keratin)), which make up [hair](https://en.wikipedia.org/wiki/Hair), [nails](https://en.wikipedia.org/wiki/Nail_%28anatomy%29), [horns](https://en.wikipedia.org/wiki/Horn_%28anatomy%29) and [reptilian](https://en.wikipedia.org/wiki/Reptile) [scales](https://en.wikipedia.org/wiki/Scale_%28zoology%29).

Regardless of the group, keratins are either acidic or basic. Acidic and basic keratins bind each other to form acidic-basic heterodimers and these heterodimers then associate to make a keratin filament.[[6]](https://en.wikipedia.org/wiki/Intermediate_filament#cite_note-interfil-6)

Cytokeratin filaments laterally associate with each other to create a thick bundle of ~50nm radius. The optimal radius of such bundles is determined by the interplay between the long range electrostatic repulsion and short range hydrophobic attraction.[[21]](https://en.wikipedia.org/wiki/Intermediate_filament#cite_note-21) Subsequently, these bundles would intersect through junctions to form a dynamic network, spanning the cytoplasm of epithelial cells.

**Type III**



[Vimentin](https://en.wikipedia.org/wiki/Vimentin) fibers in [fibroblasts](https://en.wikipedia.org/wiki/Fibroblast).

There are four proteins classed as type III IF proteins, which may form [homo-](https://en.wikipedia.org/wiki/Homopolymer) or [heteropolymeric](https://en.wikipedia.org/wiki/Heteropolymer%22%20%5Co%20%22Heteropolymer) proteins.

* [**Desmin**](https://en.wikipedia.org/wiki/Desmin) IFs are structural components of the [sarcomeres](https://en.wikipedia.org/wiki/Sarcomere) in muscle cells and connect different cell organells like the desmosomes with the cytoskeleton.[[22]](https://en.wikipedia.org/wiki/Intermediate_filament#cite_note-22)
* [**GFAP**](https://en.wikipedia.org/wiki/Glial_fibrillary_acidic_protein) (glial fibrillary acidic protein) is found in [astrocytes](https://en.wikipedia.org/wiki/Astrocyte) and other [glia](https://en.wikipedia.org/wiki/Glia).
* [**Peripherin**](https://en.wikipedia.org/wiki/Peripherin) found in peripheral neurons.
* [**Vimentin**](https://en.wikipedia.org/wiki/Vimentin), the most widely distributed of all IF proteins, can be found in [fibroblasts](https://en.wikipedia.org/wiki/Fibroblast), [leukocytes](https://en.wikipedia.org/wiki/Leukocytes), and blood vessel [endothelial cells](https://en.wikipedia.org/wiki/Endothelial_cell). They support the cellular membranes, keep some [organelles](https://en.wikipedia.org/wiki/Organelle) in a fixed place within the [cytoplasm](https://en.wikipedia.org/wiki/Cytoplasm), and transmit membrane receptor signals to the nucleus.[[6]](https://en.wikipedia.org/wiki/Intermediate_filament#cite_note-interfil-6)

**Type IV**

* [**Alpha-internexin**](https://en.wikipedia.org/wiki/Alpha-internexin)
* [**Neurofilaments**](https://en.wikipedia.org/wiki/Neurofilament) - the type IV family of intermediate filaments that is found in high concentrations along the [axons](https://en.wikipedia.org/wiki/Axon) of vertebrate neurons.
* [**Synemin**](https://en.wikipedia.org/wiki/Synemin)
* [**Syncoilin**](https://en.wikipedia.org/wiki/Syncoilin)

**Type V - nuclear lamins**[]

* [**Lamins**](https://en.wikipedia.org/wiki/Lamin)

Lamins are fibrous proteins having structural function in the cell nucleus.

In metazoan cells, there are A and B type lamins, which differ in their length I. Human cells have three differentially regulated genes. B-type lamins are present in every cell. B type lamins, [lamin B1](https://en.wikipedia.org/wiki/Lamin_B1%22%20%5Co%20%22Lamin%20B1) and [B2](https://en.wikipedia.org/wiki/Lamin_B2), are expressed from the LMNB1 and LMNB2 genes on 5q23 and 19q13, respectively. A-type lamins are only expressed following [gastrulation](https://en.wikipedia.org/wiki/Gastrulation). Lamin A and C are the most common A-type lamins and are splice variants of the LMNA gene found at 1q21.

These proteins localize to two regions of the nuclear compartment, the nuclear lamina—a proteinaceous structure layer subjacent to the inner surface of the [nuclear envelope](https://en.wikipedia.org/wiki/Nuclear_envelope) and throughout the nucleoplasm in the [nucleoplasmic veil](https://en.wikipedia.org/wiki/Cell_nucleus%22%20%5Cl%20%22Nuclear_lamina%22%20%5Co%20%22Cell%20nucleus).

Comparison of the lamins to vertebrate cytoskeletal IFs shows that lamins have an extra 42 residues (six heptads) within coil 1b. The c-terminal tail domain contains a nuclear localization signal (NLS), an Ig-fold-like domain, and in most cases a carboxy-terminal CaaX box that is isoprenylated and carboxymethylated (lamin C does not have a CAAX box). Lamin A is further processed to remove the last 15 amino acids and its farnesylated cysteine.

During mitosis, lamins are phosphorylated by MPF, which drives the disassembly of the lamina and the nuclear envelope.[[](https://en.wikipedia.org/wiki/Intermediate_filament#cite_note-interfil-6)

**Type Vi**

* Beaded filaments: [Filensin](https://en.wikipedia.org/wiki/BFSP1%22%20%5Co%20%22BFSP1), [Phakinin](https://en.wikipedia.org/wiki/BFSP2).[[6]](https://en.wikipedia.org/wiki/Intermediate_filament#cite_note-interfil-6)
* [Nestin](https://en.wikipedia.org/wiki/Nestin_%28protein%29) (was once proposed for reclassification but due to differences, remains as a type VI IF protein)[[23]](https://en.wikipedia.org/wiki/Intermediate_filament#cite_note-23)

Vertebrate-only. Related to type I-IV. Used to contain other newly-discovered IF proteins not yet assigned to a type