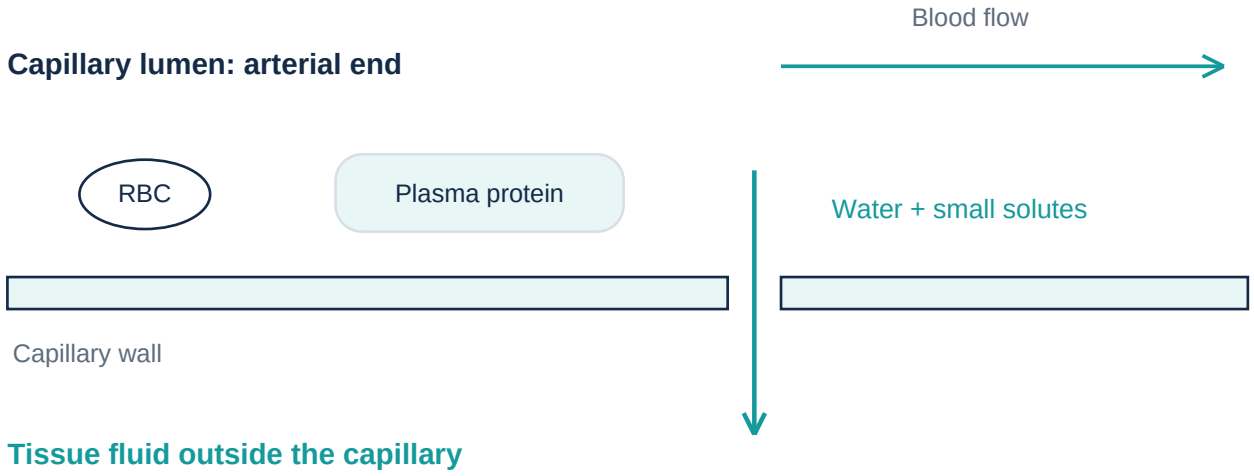
Tissue fluid begins as filtered plasma

Tissue fluid is the aqueous fluid around body cells. It forms when water and small dissolved substances leave blood plasma across a capillary wall.

1. HYDROSTATIC PRESSURE DRIVES FILTRATION



One wall shown, with an enlarged gap between endothelial cells. Symbols and gap size are schematic. Pressure drives fluid movement; red cells and most large plasma proteins are retained.

2. WHY FLUID MOVES OUT

Near the arterial end, capillary blood hydrostatic pressure is relatively high. When outward pressure exceeds the opposing effects, water and small solutes are filtered into tissue spaces. This pressure-driven process is often called ultrafiltration.

3. WHY TISSUE FLUID IS NOT IDENTICAL TO PLASMA

The capillary barrier normally retains red blood cells, platelets and most large plasma proteins. Tissue fluid therefore has much less protein than plasma. It contains water, ions and small solutes such as glucose; its composition changes as cells exchange substances with it.

Filtration is not active transport: the capillary wall does not pump plasma out using ATP. The driving pressure ultimately comes from the heart, and water carries small solutes with it.

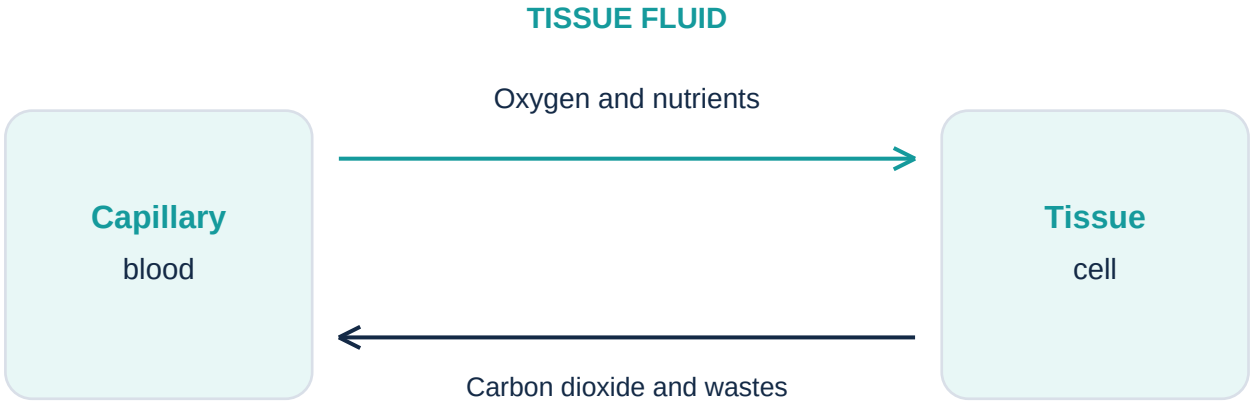
Filtration and retained plasma proteins: OpenStax Anatomy & Physiology 2e, section 20.3.
Plasma and interstitial-fluid compartments: OpenStax, section 26.1.

Scope: Cambridge Biology 9700 syllabus, section 8.1, outcome 7, p. 27.

The immediate medium for exchange

Most tissue cells are not directly bathed in blood. Tissue fluid bridges the short distance between a capillary and a cell, supplying materials and carrying away wastes.

1. FOLLOW THE TWO EXCHANGE DIRECTIONS



Direction schematic for an actively respiring body tissue, not a flow of whole cells. Individual substances cross the capillary wall, tissue fluid and cell surface by appropriate routes.

2. SUPPLY MATERIALS FOR CELL ACTIVITY

Dissolved oxygen reaches cells for aerobic respiration. Nutrients such as glucose and amino acids are available for uptake. Tissue fluid also carries ions and chemical signals. Movement across a cell membrane depends on permeability and, for many solutes, transport proteins.

3. REMOVE PRODUCTS OF METABOLISM

Respiring cells release carbon dioxide, which diffuses towards the blood through tissue fluid down its concentration gradient. Other soluble wastes can also enter tissue fluid and be carried away. Do not say that every body cell makes urea; most urea is produced in the liver.

Separate the mechanisms: hydrostatic pressure forms tissue fluid by filtration; concentration gradients drive diffusion of individual substances. Dissolving in water does not mean a solute crosses every membrane freely.

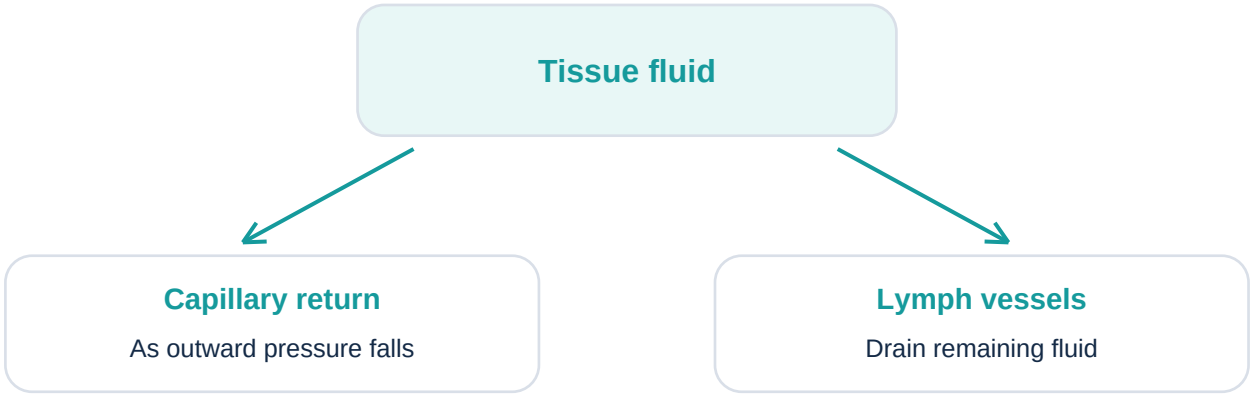
Exchange by diffusion: OpenStax Anatomy & Physiology 2e, section 20.3.
Tissue fluid as the extracellular environment: OpenStax, section 26.1.

Scope: Cambridge Biology 9700 syllabus, section 8.1, outcome 7, p. 27.

Return fluid to the circulation

Fluid leaving capillaries must be balanced by return to the blood. The usual introductory model contrasts high arterial-end pressure with lower venous-end pressure, and includes lymphatic drainage.

1. TWO RETURN ROUTES IN THE TEACHING MODEL



2. LOWER HYDROSTATIC PRESSURE FAVOURS RETURN

Blood hydrostatic pressure falls along a capillary. Retained plasma proteins lower plasma water potential, opposing outward filtration. In the simplified model, water returns by osmosis at the venous end when the inward effect exceeds outward pressure.

3. LYMPHATIC DRAINAGE PREVENTS BUILD-UP

Fluid entering lymphatic capillaries is called lymph. Lymph vessels return it, together with escaped proteins, to the venous blood. If filtration exceeds removal for a sustained period, fluid accumulates in tissues: oedema. Lymph is not returned through an artery.

Model limit: many tissues continue to filter fluid at steady state rather than showing sustained venous-end reabsorption. Lymphatic drainage is therefore essential. Use the simplified model to explain the opposing forces, not as a claim about every capillary.

Introductory pressure model: OpenStax Anatomy & Physiology 2e, section 20.3.
Lymph return: OpenStax, section 21.1.
Model limits: Levick (2004), Revision of the Starling principle.

Scope: Cambridge Biology 9700 syllabus, section 8.1, outcome 7, p. 27.