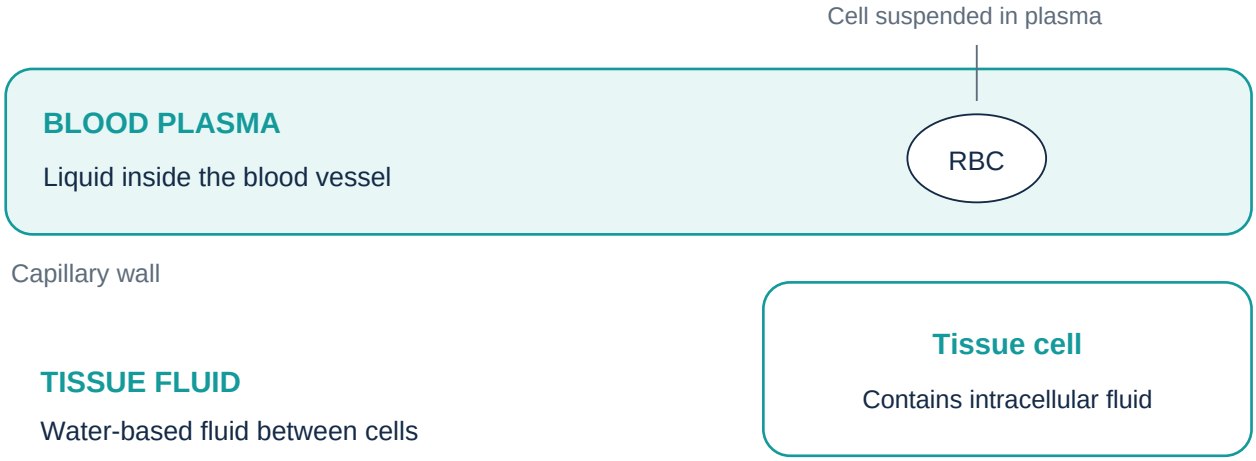
A watery transport medium

Water is the main component of blood and tissue fluid. Focus on two properties: it dissolves many transported substances, and it resists large temperature changes.

1. DISTINGUISH THE FLUID COMPARTMENTS



Location schematic, not a diagram of tissue-fluid formation. Plasma and tissue fluid are extracellular: outside cells. Red blood cells are suspended in plasma, not dissolved in it.

2. PLASMA IS THE LIQUID PART OF BLOOD

Whole blood includes plasma, blood cells and platelets. Plasma is mostly water, with dissolved proteins and other solutes. Do not use plasma as another name for the entire blood, and do not describe blood as pure water.

3. TISSUE FLUID SURROUNDS BODY CELLS

Tissue fluid fills spaces around tissue cells and provides their immediate aqueous environment. It contains dissolved substances but has a different composition from plasma. It is outside the cells, not the fluid within their cytoplasm.

Keep the property-to-role link explicit: solvent action supports transport of dissolved materials; high specific heat capacity helps blood transport heat while limiting temperature fluctuations.

Plasma and formed elements: OpenStax Anatomy & Physiology, section 18.1.
Extracellular fluid compartments: OpenStax Anatomy & Physiology 2e, section 26.1.

Scope: Cambridge Biology 9700 syllabus, section 8.1, outcome 6, p. 27.

Solvent action: carry useful solutes

A solvent is the substance in which a solute dissolves. Water molecules are polar: their uneven charge distribution lets them interact with ions and many polar molecules.

1. EXAMPLES OF DISSOLVED MATERIALS

MATERIAL	TRANSPORT ROLE
Glucose	Nutrient supplied to cells
Amino acids	Raw materials for protein synthesis
Urea	Nitrogenous waste carried to kidneys
Mineral ions	Ions such as sodium and chloride

Examples rather than an exhaustive list. Dissolved solutes can be carried with the bulk flow of plasma; water does not chemically turn them into new substances just by dissolving them.

2. POLARITY HELPS SUBSTANCES STAY IN SOLUTION

The partially negative oxygen end of water is attracted to positive ions; its partially positive hydrogen ends are attracted to negative ions. Water also interacts with many polar solutes. Surrounding particles with water helps disperse them in solution.

3. TRANSPORT AND CELL UPTAKE ARE DIFFERENT

Blood flow moves dissolved material over long distances. Near tissues, exchange with tissue fluid brings suitable solutes close to cells. Crossing a cell membrane depends on the substance and available transport proteins; being soluble does not guarantee free passage.

Water is not a universal solvent. Many lipids need carrier arrangements in blood, and most oxygen is carried bound to haemoglobin in red blood cells rather than simply dissolved in plasma.

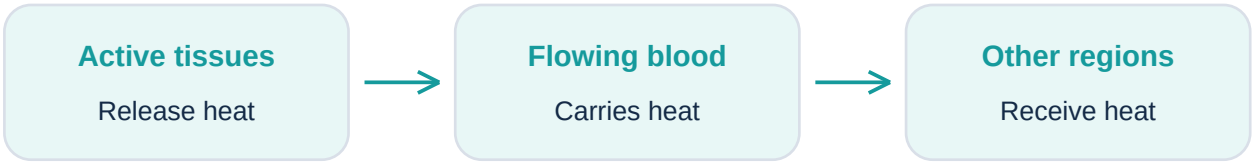
Polarity and solvent action: OpenStax Biology 2e, section 2.2.
Plasma solutes and transport context: OpenStax Anatomy & Physiology, section 18.1.

Scope: Cambridge Biology 9700 syllabus, section 8.1, outcome 6, p. 27.

High specific heat capacity

Specific heat capacity is the energy needed to raise the temperature of a unit mass by one degree. Water needs a relatively large energy input for a small temperature rise.

1. HEAT CAN MOVE WITHOUT A LARGE TEMPERATURE RISE



Blood redistributes heat from metabolically active tissues. Its high water content lets it carry appreciable thermal energy with only a modest change in temperature.

Heat distribution is not the same as heat loss: blood can also carry heat towards the skin, where transfer to the surroundings depends on conditions.

2. HYDROGEN BONDING HELPS EXPLAIN THE PROPERTY

Energy is needed to disrupt some of the hydrogen bonds between water molecules as water warms. This contributes to its high specific heat capacity. The covalent O-H bonds within the molecules are not broken by ordinary warming.

3. A NUMERICAL ILLUSTRATION, NOT A REQUIRED CALCULATION

For water, about 4.2 kJ raises 1 kg by 1 °C. A high specific heat capacity means a small temperature rise for a given energy input and mass. This is an illustration using water, not an exact value for whole blood.

Temperature buffering helps protect enzyme-controlled reactions from rapid changes. It does not prevent all temperature change or replace thermoregulation. Specific heat capacity is different from latent heat of vaporisation, the property involved in evaporating sweat.

Specific heat capacity, units and water: USGS Water Science School.
Hydrogen bonding and temperature stability: OpenStax Biology 2e, section 2.2.

Scope: Cambridge Biology 9700 syllabus, section 8.1, outcome 6, p. 27.