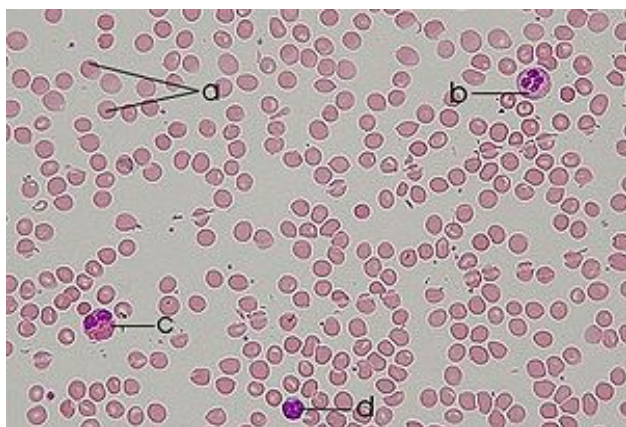
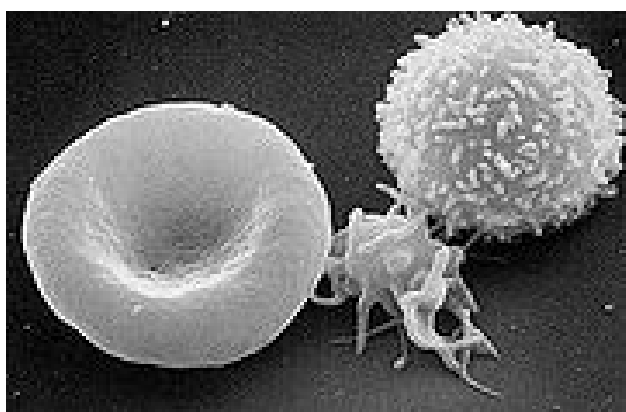




Blood



Human blood smear:
a - erythrocytes; b - neutrophil;
c - eosinophil; d - lymphocyte.



A scanning electron microscope (SEM) image of a normal red blood cell, a platelet, and a white blood cell.

Blood is a specialized bodily fluid that delivers necessary substances to the body's cells — such as nutrients and oxygen — and transports waste products away from those same cells.

In vertebrates, it is composed of blood cells suspended in a liquid called blood plasma. Plasma, which comprises 55% of blood fluid, is mostly water (90% by volume),^[1] and contains dissolved proteins, glucose, mineral ions, hormones, carbon dioxide (plasma being the main medium for excretory product transportation), platelets and blood cells themselves. The blood cells present in blood are mainly red blood cells (also called RBCs or erythrocytes) and white blood cells, including leukocytes and platelets. The most abundant cells in vertebrate

blood are red blood cells. These contain hemoglobin, an iron-containing protein, which facilitates transportation of oxygen by reversibly binding to this respiratory gas and greatly increasing its solubility in blood. In contrast, carbon dioxide is almost entirely transported extracellularly dissolved in plasma as bicarbonate ion.

Vertebrate blood is bright-red when its hemoglobin is oxygenated. Some animals, such as crustaceans and mollusks, use hemocyanin to carry oxygen, instead of hemoglobin. Insects and some molluscs use a fluid called hemolymph instead of blood, the difference being that hemolymph is not contained in a closed circulatory system. In most insects, this "blood" does not contain oxygen-carrying molecules such as hemoglobin because their bodies are small enough for their tracheal system to suffice for supplying oxygen.

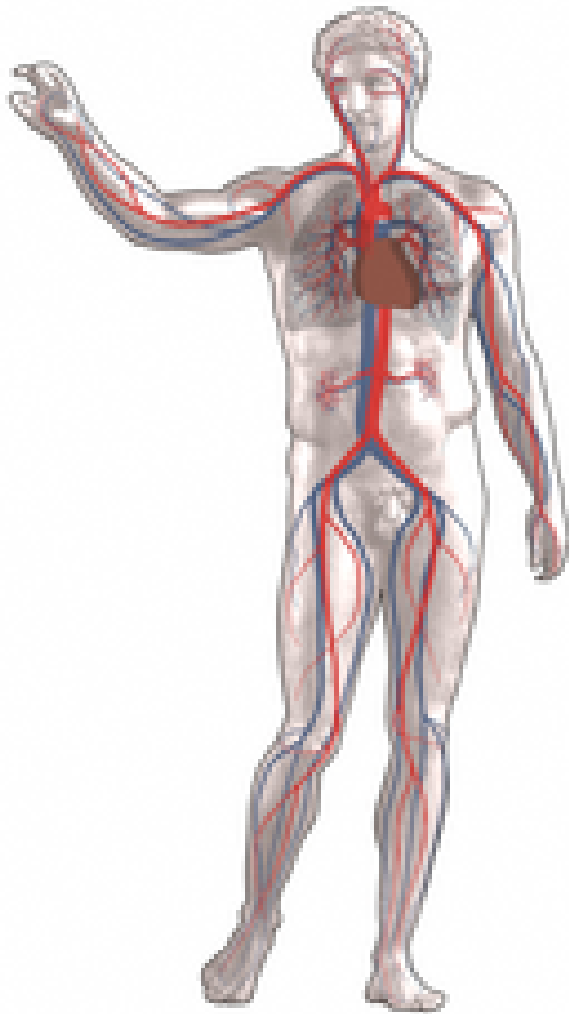
Jawed vertebrates have an adaptive immune system, based largely on white blood cells. White blood cells help to resist infections and parasites. Platelets are important in the clotting of blood.^[2] Arthropods, using hemolymph, have hemocytes as part of their immune system.

Blood is circulated around the body through blood vessels by the pumping action of the heart. In animals having lungs, arterial blood carries oxygen from inhaled air to the tissues of the body, and venous blood carries carbon dioxide, a waste product of metabolism produced by cells, from the tissues to the lungs to be exhaled.

Medical terms related to blood often begin with *hemo-* or *hemato-* (also spelled *haemo-* and *haemato-*) from the Ancient Greek word αἷμα (*haima*) for "blood". In terms of anatomy and histology, blood is considered a specialized form of connective tissue, given its origin in the bones and the presence of potential molecular fibers in the form of fibrinogen.

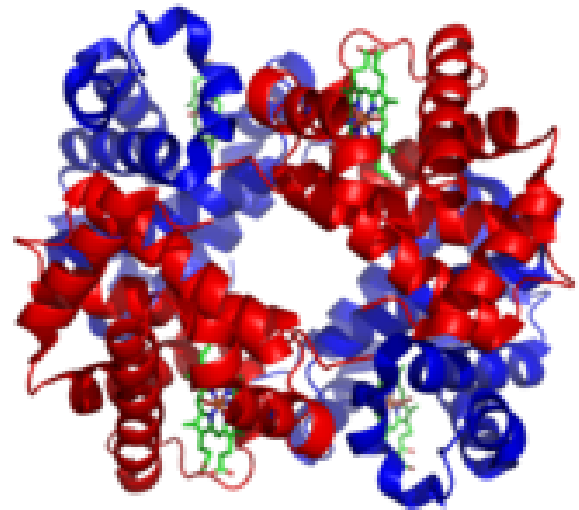
Functions

Blood performs many important functions within the body including:

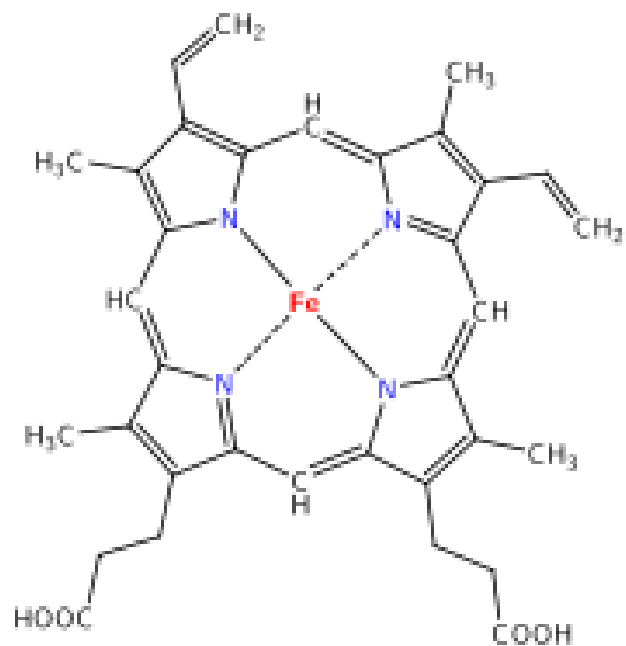


Blood circulation:
 Red = oxygenated
 Blue = deoxygenated

- Supply of **oxygen** to tissues (bound to hemoglobin, which is carried in red cells)
- Supply of nutrients such as **glucose**, **amino acids**, and **fatty acids** (dissolved in the blood or bound to plasma proteins (e.g., blood lipids))
- Removal of waste such as **carbon dioxide**, **urea**, and **lactic acid**
- Immunological functions, including circulation of **white blood cells**, and detection of foreign material by **antibodies**
- **Coagulation**, which is one part of the body's self-repair mechanism
- Messenger functions, including the transport of **hormones** and the signaling of **tissue damage**
- Regulation of body **pH** (the normal pH of blood is in the range of 7.35 - 7.45)^[3] (covering only 0.1 pH unit)
- Regulation of core **body temperature**
- Hydraulic functions



Hemoglobin
 green = heme groups
 red & blue = protein subunits



Heme

Constituents of human blood

See also: Reference ranges for common blood tests

Blood accounts for 7% of the human body weight,^[4] with an average density of approximately 1060 kg/m³, very close to pure water's density of 1000 kg/m³.^[5] The average adult has a blood volume of roughly 5 liters, composed of plasma and several kinds of cells (occasionally called *corpuscles*); these



Two tubes of EDTA-anticoagulated blood. Left tube: after standing, the RBCs have settled at the bottom of the tube. Right tube: contains freshly drawn blood.

formed elements of the blood are erythrocytes (red blood cells), leukocytes (white blood cells), and thrombocytes (platelets). By volume, the red blood cells constitute about 45% of whole blood, the plasma constitutes about 54.3%, white cells constitute 0.7%.

Whole blood (plasma and cells) exhibits non-Newtonian fluid dynamics; its flow properties are adapted to flow effectively through tiny capillary blood vessels with less resistance than plasma by itself. In addition, if all human hemoglobin were free in the plasma rather than being contained in RBCs, the circulatory fluid would be too viscous for the cardiovascular system to function effectively.

Cells

Further information: **Complete blood count**

One microliter of blood contains:

- [6] In mammals, mature red blood cells lack a nucleus and organelles. They contain the blood's hemoglobin and distribute oxygen. The red blood cells (together with endothelial vessel cells and other cells) are also marked by

glycoproteins that define the different blood types. The proportion of blood occupied by red blood cells is referred to as the hematocrit, and is normally about 45%. The combined surface area of all red blood cells of the human body would be roughly 2,000 times as great as the body's exterior surface.[7]

- [8] White blood cells are part of the immune system; they destroy and remove old or aberrant cells and cellular debris, as well as attack infectious agents (pathogens) and foreign substances. The cancer of leukocytes is called leukemia.
- [8] thrombocytes, also called platelets, are responsible for blood clotting (coagulation). They change fibrinogen into fibrin. This fibrin creates a mesh onto which red blood cells collect and clot, which then stops more blood from leaving the body and also helps to prevent bacteria from entering the body.

Constitution of normal blood

Parameter	Value
Hematocrit	45 ± 7 (38 - 52%) for males 42 ± 5 (37 - 47%) for females
pH	7.35 - 7.45
base excess	-3 to +3
PO ₂	10 - 13 kPa (80 - 100 mm Hg)
PCO ₂	4.8 - 5.8 kPa (35 - 45 mm Hg)
HCO ₃ ⁻	21 mM - 27 mM
Oxygen saturation	Oxygenated: 98 - 99% Deoxygenated: 75%

Plasma

About 55% of whole blood is blood plasma, a fluid that is the blood's liquid medium, which by itself is straw-yellow in color. The blood plasma volume totals of 2.7 - 3.0 litres in an average human. It is essentially an aqueous solution containing 92% water, 8% blood plasma proteins, and trace amounts of other materials. Plasma circulates dissolved nutrients, such as glucose, amino acids, and fatty acids (dissolved in the blood or bound to plasma proteins), and removes waste products, such as carbon dioxide, urea, and lactic acid.

Other important components include:

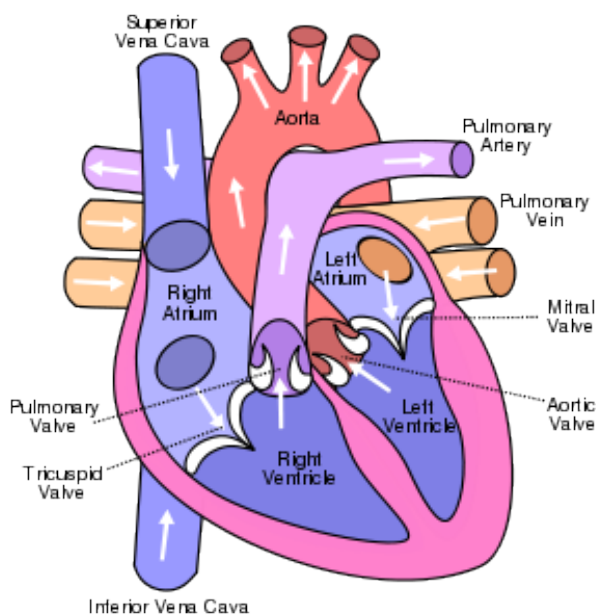
- Serum albumin
- Blood-clotting factors (to facilitate coagulation)
- Immunoglobulins (antibodies)
- lipoprotein particles
- Various other proteins
- Various electrolytes (mainly sodium and chloride)

The term **serum** refers to plasma from which the clotting proteins have been removed. Most of the proteins remaining are albumin and immunoglobulins.

The normal pH of human arterial blood is approximately 7.40 (normal range is 7.35 - 7.45), a weakly alkaline solution. Blood that has a pH below 7.35 is too acidic, whereas blood pH above 7.45 is too alkaline. Blood pH, partial pressure of oxygen (pO₂), partial pressure of carbon dioxide (pCO₂), and HCO₃ are carefully regulated by a number of homeostatic mechanisms, which exert their influence principally through the respiratory system and the urinary system in order to control the acid-base balance and respiration. Plasma also circulates hormones transmitting their messages to various tissues. The list of normal reference ranges for various blood electrolytes is extensive.

Physiology

Cardiovascular system



The circulation of blood through the human heart

Blood is circulated around the body through **blood vessels** by the pumping action of the heart. In humans, blood is pumped from the strong left ventricle of the heart through **arteries** to **peripheral tissues** and returns to the right **atrium** of the heart through **veins**. It then enters the right ventricle and is pumped through the **pulmonary artery** to the lungs and returns to the left atrium through the **pulmonary veins**. Blood then enters the left ventricle to be circulated again. Arterial blood carries oxygen from inhaled air to all of the cells of the body, and venous blood carries carbon dioxide, a waste product of **metabolism** by **cells**, to the lungs to be exhaled. However, one exception includes pulmonary arteries, which contain the most deoxygenated blood in the body, while the pulmonary veins contain oxygenated blood.

Additional return flow may be generated by the movement of skeletal muscles, which can compress veins and push blood through the valves in veins toward the right atrium.

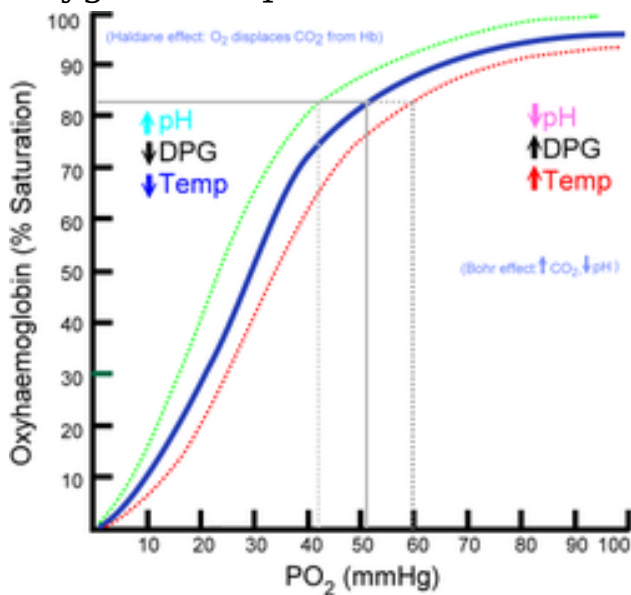
The blood circulation was famously described by William Harvey in 1628.^[9]

Production and degradation of blood cells

In vertebrates, the various cells of blood are made in the **bone marrow** in a process called **hematopoiesis**, which includes **erythropoiesis**, the production of red blood cells; and **myelopoiesis**, the production of white blood cells and platelets. During childhood, almost every human bone produces red blood cells; as adults, red blood cell production is limited to the larger bones: the bodies of the vertebrae, the breastbone (sternum), the ribcage, the pelvic bones, and the bones of the upper arms and legs. In addition, during childhood, the **thymus gland**, found in the **mediastinum**, is an important source of **lymphocytes**.^[10] The proteinaceous component of blood (including clotting proteins) is produced predominantly by the liver, while hormones are produced by the **endocrine glands** and the watery fraction is regulated by the **hypothalamus** and maintained by the kidney.

Healthy erythrocytes have a plasma life of about 120 days before they are degraded by the spleen, and the Kupffer cells in the liver. The liver also clears some proteins, lipids, and **amino acids**. The kidney actively secretes waste products into the urine.

Oxygen transport



Basic hemoglobin saturation curve. It is moved to the right in higher acidity (more dissolved carbon dioxide) and to the left in lower acidity (less dissolved carbon dioxide)

Further information: **Oxygen transportation**

About 98.5% of the oxygen in a sample of arterial blood in a healthy human breathing air at sea-level pressure is chemically combined with the Hgb. About 1.5% is physically dissolved in the other blood liquids and not connected to Hgb. The hemoglobin molecule is the primary transporter of oxygen in mammals and many other species (for exceptions, see below).

With the exception of pulmonary and umbilical arteries and their corresponding veins, arteries carry oxygenated blood away from the heart and deliver it to the body via arterioles and capillaries, where the oxygen is consumed; afterwards, venules, and veins carry deoxygenated blood back to the heart.

Under normal conditions in humans at rest, hemoglobin in blood leaving the lungs is about 98-99% saturated with oxygen. In a healthy adult at rest, deoxygenated blood returning to the lungs is still approximately 75% saturated.^{[11][12]} Increased oxygen consumption during sustained exercise reduces the oxygen saturation of venous blood, which can reach less than 15% in a trained athlete; although breathing rate and blood flow increase to compensate, oxygen saturation in arterial blood can drop to 95% or less under these conditions.^[13] Oxygen saturation this low is considered dangerous in an individual at rest (for instance, during surgery under

anesthesia. Sustained hypoxia (oxygenation of less than 90%), is dangerous to health, and severe hypoxia (saturation of less than 30%) may be rapidly fatal.^[14]

A fetus, receiving oxygen via the placenta, is exposed to much lower oxygen pressures (about 21% of the level found in an adult's lungs), and, so, fetuses produce another form of hemoglobin with a much higher affinity for oxygen (hemoglobin F) in order to function under these conditions.^[15]

Carbon dioxide transport

When blood flows through capillaries, carbon dioxide diffuses from the tissues into the blood. Some carbon dioxide is dissolved in the blood. Some carbon dioxide reacts with hemoglobin and other proteins to form carbamino compounds. The remaining carbon dioxide is converted to bicarbonate and hydrogen ions through the action of RBC carbonic anhydrase. Most carbon dioxide is transported through the blood in the form of bicarbonate ions.

Carbon dioxide (CO₂), the main cellular waste product is carried in blood mainly dissolved in plasma, in equilibrium with bicarbonate (HCO₃⁻) and carbonic acid (H₂CO₃). 86%-90% of CO₂ in the body is converted into carbonic acid, which can quickly turn into bicarbonate, the chemical equilibrium being important in the pH buffering of plasma.^[16] Blood pH is kept in a narrow range (pH between 7.35-7.45).^[17]

Transport of hydrogen ions

Some oxyhemoglobin loses oxygen and becomes deoxyhemoglobin. Deoxyhemoglobin binds most of the hydrogen ions as it has a much greater affinity for more hydrogen than does oxyhemoglobin.

Lymphatic system

In mammals, blood is in equilibrium with lymph, which is continuously formed in tissues from blood by capillary ultrafiltration. Lymph is collected by a system of small lymphatic vessels and directed to the thoracic duct, which drains into the left subclavian vein where lymph rejoins the systemic blood circulation.

Thermoregulation

Blood circulation transports **heat** throughout the body, and adjustments to this flow are an important part of **thermoregulation**. Increasing blood flow to the surface (e.g., during warm weather or strenuous exercise) causes warmer skin, resulting in faster heat loss. In contrast, when the external temperature is low, blood flow to the extremities and surface of the skin is reduced and to prevent heat loss and is circulated to the important organs of the body, preferentially.

Hydraulic functions

The restriction of blood flow can also be used in specialized tissues to cause engorgement, resulting in an erection of that tissue; examples are the erectile tissue in the penis, nipples, and clitoris.

Another example of a hydraulic function is the jumping spider, in which blood forced into the legs under pressure causes them to straighten for a powerful jump, without the need for bulky muscular legs.^[18]

Invertebrates

In insects, the blood (more properly called **hemolymph**) is not involved in the transport of oxygen. (Openings called **tracheae** allow oxygen from the air to diffuse directly to the tissues). Insect blood moves nutrients to the tissues and removes waste products in an open system.

Other invertebrates use respiratory proteins to increase the oxygen-carrying capacity. Hemoglobin is the most common respiratory protein found in nature. **Hemocyanin** (blue) contains **copper** and is found in **crustaceans** and **mollusks**. It is thought that **tunicates** (sea squirts) might use **vanabins** (proteins containing **vanadium**) for respiratory pigment (bright-green, blue, or orange).

In many invertebrates, these oxygen-carrying proteins are freely soluble in the blood; in vertebrates they are contained in specialized **red blood cells**, allowing for a higher concentration of respiratory pigments without increasing viscosity or damaging blood filtering organs like the kidneys.

Giant tube worms have unusual hemoglobins that allow them to live in extraordinary environments. These hemoglobins also carry sulfides normally fatal in other animals.

Color

Hemoglobin



Capillary blood from a bleeding finger



Venous blood collected during blood donation

Hemoglobin is the principal determinant of the color of blood in vertebrates. Each molecule has four heme groups, and their interaction with various molecules alters the exact color. In **vertebrates** and other hemoglobin-using creatures, arterial blood and capillary blood are bright-red, as oxygen imparts a strong red color to the heme group. Deoxygenated blood is a darker shade of red; this is present in veins, and can be seen during **blood donation** and when venous blood samples are taken. Blood in **carbon monoxide poisoning** is bright-red, because **carbon monoxide** causes the formation of **carboxyhemoglobin**. In cyanide poisoning, the body cannot utilize oxygen, so the venous blood remains oxygenated, increasing the redness. While hemoglobin-containing blood is never blue, there are several conditions and diseases wherein the color of the heme groups make the skin appear blue. If the heme is oxidized, **methaemoglobin**, which is more

brownish and cannot transport oxygen, is formed. In the rare condition **sulfhemoglobinemia**, arterial hemoglobin is partially oxygenated, and appears dark-red with a bluish hue (**cyanosis**).

Veins in the skin appear blue for a variety of reasons only weakly dependent on the color of the blood. Light scattering in the skin, and the visual processing of color play roles as well.^[19]

Skinks in the genus *Prasinochaema* have green blood due to a buildup of the waste product **biliverdin**.^[20]

Hemocyanin

The blood of most **molluscs** - including **cephalopods** and **gastropods** - as well as some **arthropods**, such as **horseshoe crabs**, is blue, as it contains the copper-containing protein **hemocyanin** at concentrations of about 50 grams per litre.^[21] Hemocyanin is colorless when deoxygenated and dark blue when oxygenated. The blood in the circulation of these creatures, which generally live in cold environments with low oxygen tensions, is grey-white to pale yellow,^[21] and it turns dark blue when exposed to the oxygen in the air, as seen when they bleed.^[21] This is due to change in color of **hemocyanin** when it is oxidized.^[21] Hemocyanin carries oxygen in extracellular fluid, which is in contrast to the intracellular oxygen transport in mammals by hemoglobin in RBCs.^[21]

Pathology

General medical disorders

- Disorders of volume
 - Injury** can cause blood loss through **bleeding**.^[22] A healthy adult can lose almost 20% of blood volume (1L) before the first symptom, restlessness, begins, and 40% of volume (2L) before **shock** sets in. **Thrombocytes** are important for blood **coagulation** and the formation of blood clots, which can stop bleeding. Trauma to the internal organs or bones can cause **internal bleeding**, which can sometimes be severe.
 - Dehydration** can reduce the blood volume by reducing the water content of the blood. This would rarely result in **shock** (apart from the very severe

cases) but may result in **orthostatic hypotension** and **fainting**.

- Disorders of circulation
 - Shock** is the ineffective perfusion of tissues, and can be caused by a variety of conditions including blood loss, **infection**, poor cardiac output.
 - Atherosclerosis** reduces the flow of blood through arteries, because **atheroma** lines arteries and narrows them. Atheroma tends to increase with age, and its progression can be compounded by many causes including smoking, **high blood pressure**, excess circulating lipids (**hyperlipidemia**), and **diabetes mellitus**.
 - Coagulation can form a **thrombosis**, which can obstruct vessels.
 - Problems with blood composition, the pumping action of the heart, or narrowing of blood vessels can have many consequences including **hypoxia** (lack of oxygen) of the tissues supplied. The term *ischemia* refers to tissue that is inadequately perfused with blood, and *infarction* refers to tissue death (**necrosis**), which can occur when the blood supply has been blocked (or is very inadequate).

Hematological disorders

See also: **Hematology**

- Anemia**
 - Insufficient red cell mass (anemia) can be the result of bleeding, blood disorders like **thalassemia**, or nutritional deficiencies; and may require **blood transfusion**. Several countries have **blood banks** to fill the demand for transfusable blood. A person receiving a blood transfusion must have a **blood type** compatible with that of the donor.
 - Sickle-cell anemia**
- Disorders of cell proliferation
 - Leukemia** is a group of cancers of the blood-forming tissues.
 - Non-cancerous overproduction of red cells (**polycythemia vera**) or platelets (**essential thrombocytosis**) may be **pre-malignant**.
 - Myelodysplastic syndromes** involve ineffective production of one or more cell lines.
- Disorders of coagulation

- **Hemophilia** is a genetic illness that causes dysfunction in one of the blood's clotting mechanisms. This can allow otherwise inconsequential wounds to be life-threatening, but more commonly results in **hemarthrosis**, or bleeding into joint spaces, which can be crippling.
- Ineffective or insufficient platelets can also result in **coagulopathy** (bleeding disorders).
- Hypercoagulable state (**thrombophilia**) results from defects in regulation of platelet or clotting factor function, and can cause thrombosis.
- Infectious disorders of blood
 - Blood is an important vector of infection. **HIV**, the virus, which causes **AIDS**, is transmitted through contact with blood, semen or other body secretions of an infected person. **Hepatitis B** and **C** are transmitted primarily through blood contact. Owing to **blood-borne infections**, bloodstained objects are treated as a **biohazard**.
 - Bacterial infection of the blood is **bacteremia** or **sepsis**. Viral Infection is **viremia**. **Malaria** and **trypanosomiasis** are blood-borne parasitic infections.

Carbon monoxide poisoning

Substances other than oxygen can bind to hemoglobin; in some cases this can cause irreversible damage to the body. **Carbon monoxide**, for example, is extremely dangerous when carried to the blood via the lungs by inhalation, because carbon monoxide irreversibly binds to hemoglobin to form **carboxyhemoglobin**, so that less hemoglobin is free to bind oxygen, and less oxygen can be transported in the blood. This can cause suffocation insidiously. A fire burning in an enclosed room with poor ventilation presents a very dangerous hazard, since it can create a build-up of carbon monoxide in the air. Some carbon monoxide binds to hemoglobin when smoking **tobacco**.

Medical treatments

Blood products

Further information: **Blood transfusion**
 Blood for transfusion is obtained from human donors by **blood donation** and stored in a

blood bank. There are many different blood types in humans, the **ABO blood group system**, and the **Rhesus blood group system** being the most important. Transfusion of blood of an incompatible blood group may cause severe, often fatal, complications, so **cross-matching** is done to ensure that a compatible blood product is transfused.

Other blood products administered intravenously are platelets, blood plasma, cryoprecipitate, and specific coagulation factor concentrates.

Intravenous administration

Many forms of medication (from **antibiotics** to **chemotherapy**) are administered intravenously, as they are not readily or adequately absorbed by the digestive tract.

After severe acute blood loss, liquid preparations, generically known as **plasma expanders**, can be given intravenously, either solutions of salts (NaCl, KCl, CaCl₂ etc...) at physiological concentrations, or colloidal solutions, such as **dextrans**, **human serum albumin**, or **fresh frozen plasma**. In these emergency situations, a plasma expander is a more effective life-saving procedure than a blood transfusion, because the metabolism of transfused red blood cells does not restart immediately after a transfusion.

Bloodletting

In modern evidence-based medicine, bloodletting is used in management of a few rare diseases, including **hemochromatosis** and **polycythemia**. However, **bloodletting** and **leeching** were common unvalidated interventions used until the 19th century, as many diseases were incorrectly thought to be due to an excess of blood, according to **Hippocratic medicine**.

History

Classical Greek medicine

In classical Greek medicine, blood was associated with air, with Springtime, and with a merry and gluttonous (*sanguine*) personality. It was also believed to be produced exclusively by the liver.

Hippocratic medicine

In **Hippocratic medicine**, blood was considered to be one of the **four humors**, the

others being phlegm, yellow bile, and black bile.

Myths

Due to its importance to life, blood is associated with a large number of beliefs. One of the most basic is the use of blood as a symbol for family relationships; to be "related by blood" is to be related by ancestry or descent, rather than marriage. This bears closely to bloodlines, and sayings such as "blood is thicker than water" and "bad blood", as well as "Blood brother". Blood is given particular emphasis in the Jewish and Christian religions because Leviticus 17:11 says "the life of a creature is in the blood." This phrase is part of the Levitical law forbidding the drinking of blood or eating meat with the blood still intact instead of being poured off.

Mythic references to blood can sometimes be connected to the life-giving nature of blood, seen in such events as childbirth, as contrasted with the blood of injury or death.

Indigenous Australians

In many indigenous Australian Aboriginal peoples' traditions, ochre (particularly red) and blood, both high in iron content and considered Maban, are applied to the bodies of dancers for ritual. As Lawlor states:

In many Aboriginal rituals and ceremonies, red ochre is rubbed all over the naked bodies of the dancers. In secret, sacred male ceremonies, blood extracted from the veins of the participant's arms is exchanged and rubbed on their bodies. Red ochre is used in similar ways in less-secret ceremonies. Blood is also used to fasten the feathers of birds onto people's bodies. Bird feathers contain a protein that is highly magnetically sensitive.^[23]

Lawlor comments that blood employed in this fashion is held by these peoples to attune the dancers to the invisible energetic realm of the Dreamtime. Lawlor then connects these invisible energetic realms and magnetic fields, because iron is magnetic.

Indo-European paganism

Among the Germanic tribes (such as the Anglo-Saxons and the Norsemen), blood was used during their sacrifices; the *Blóts*. The blood was considered to have the power of its originator, and, after the butchering, the blood was sprinkled on the walls, on the statues of the gods, and on the participants themselves. This act of sprinkling blood was called *bleodsian* in Old English, and the terminology was borrowed by the Roman Catholic Church becoming *to bless* and *blessing*. The Hittite word for blood, *ishar* was a cognate to words for "oath" and "bond", see *Ishara*. The Ancient Greeks believed that the blood of the gods, *ichor*, was a mineral that was poisonous to mortals.

Judaism

In Judaism, blood cannot be consumed even in the smallest quantity (Leviticus 3:17 and elsewhere); this is reflected in Jewish dietary laws (Kashrut). Blood is purged from meat by salting and soaking in water.

Another ritual involving blood involves the covering of the blood of fowl and game after slaughtering (Leviticus 17:13); the reason given by the Torah is: "Because the life of every animal is [in] his blood" (ibid 17:14).

Christianity

Some Christian churches, including Roman Catholicism, Eastern Orthodoxy, Oriental Orthodoxy, and the Assyrian Church of the East teach that, when consecrated, the Eucharistic wine actually *becomes* the blood of Jesus. Thus in the consecrated wine, Jesus becomes spiritually and physically present. This teaching is rooted in the Last Supper, as written in the four gospels of the Bible, in which Jesus stated to his disciples that the bread that they ate was his body, and the wine was his blood. "*This cup is the new testament in my blood, which is shed for you.*" (Luke 22:20).

Various forms of Protestantism, especially those of a Wesleyan or Presbyterian lineage, teach that the wine is no more than a symbol of the blood of Christ, who is spiritually but not physically present. Lutheran theology teaches that the body and blood is present together "in, with, and under" the bread and wine of the Eucharistic feast.

Christ's blood is also seen as the means for atonement for sins for Christians.

At the Council of Jerusalem, the apostles prohibited Christians from consuming blood, probably because this was a command given to Noah (Genesis 9:4, see Noahide Law). This command continued to be observed by the Eastern Orthodox.

Islam

Consumption of food containing blood is forbidden by Islamic dietary laws. This is derived from the statement in the Qur'an, sura Al-Ma'ida (5:3): "Forbidden to you (for food) are: dead meat, blood, the flesh of swine, and that on which hath been invoked the name of other than Allah."

Jehovah's Witnesses

Based on their interpretation of the Bible, Jehovah's Witnesses do not eat blood or accept transfusions of whole blood or its four major components namely, red blood cells, white blood cells, platelets (thrombocytes), and whole plasma. Members are instructed to personally decide whether or not to accept fractions and medical procedures that involve their own blood.

Chinese and Japanese culture

In Chinese popular culture, it is often said that, if a man's nose produces a small flow of blood, this signifies that he is experiencing sexual desire. This often appears in Chinese-language and Hong Kong films as well as in Japanese culture parodied in anime and manga. Characters, mostly males, will often be shown with a nosebleed if they have just seen someone nude or in little clothing, or if they have had an erotic thought or fantasy; this is based on the idea that a male's blood pressure will spike dramatically when aroused.^[24]

Blood libel

Various religious and other groups have been falsely accused of using human blood in rituals; such accusations are known as blood libel. The most common form of this is blood libel against Jews. Although there is no ritual involving human blood in Jewish law or custom, fabrications of this nature (often involving the murder of children) were widely used during the Middle Ages to justify Antisemitic persecution.

Vampire legends

Vampires are mythical creatures that drink blood directly for sustenance, usually with a preference for human blood. Cultures all over the world have myths of this kind; for example the 'Nosferatu' legend, a human who achieves damnation and immortality by drinking the blood of others, originates from Eastern European folklore. Ticks, leeches, female mosquitoes, vampire bats, and an assortment of other natural creatures do drink blood, but only bats are associated with vampires. This has no relation to vampire bats which are new world creatures discovered well after the origins of the European myths.

Entertainment

Art

Blood is one of the body fluids that have been used in art.^[25] In particular, the performances of Viennese Actionist Hermann Nitsch, Franko B, Lennie Lee, Ron Athey, Yang Zhichao, and Kira O' Reilly, along with the photography of Andres Serrano, have incorporated blood as a prominent visual element. Marc Quinn has made sculptures using frozen blood, including a cast of his own head made using his own blood. Blood is also the main *leitmotiv* in *Maligno Art*.

Films

Blood is commonly associated with gore in motion pictures. Films with bloody scenes tend to receive a high rating by film licensing bodies, ranging from PG-13 to NC-17, depending on its depiction and its prominence.

See also

- Autotransfusion
- Blood as food: see black pudding and *tiết canh*
- Blood donation
- Blood substitutes ("Artificial blood")
- Blood test
- Hemophobia
- List of human blood components
- Taboo food and drink: Blood

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