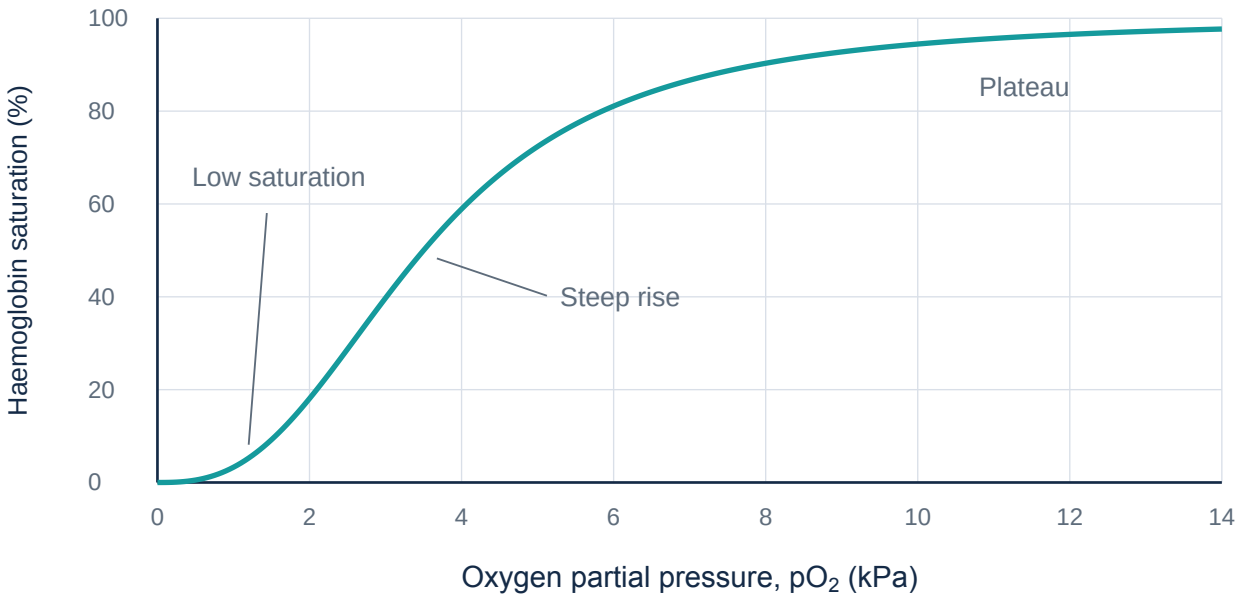
What the curve shows

An oxygen dissociation curve relates oxygen partial pressure to the percentage of haemoglobin oxygen-binding sites occupied. It describes reversible binding, not a change over time.

1. ADULT HAEMOGLOBIN: A SIGMOID CURVE



Illustrative model, not measured data: a Hill curve with exponent 2.7 and 50% saturation at 3.5 kPa. Values are for graph-reading practice; conditions affect real curves.

2. THE HORIZONTAL AXIS: OXYGEN PARTIAL PRESSURE

Partial pressure is the pressure contributed by oxygen in a gas mixture. In blood it reflects the dissolved oxygen in equilibrium with that gas. Higher pO_2 generally means more oxygen binds to haemoglobin. This graph uses kilopascals (kPa), not percentage oxygen.

3. THE VERTICAL AXIS: PERCENTAGE SATURATION

Saturation is the percentage of available haemoglobin oxygen-binding sites occupied by oxygen. At 100%, all are occupied; at 50%, half are occupied across the sample. It is not the percentage of blood made of oxygen, nor the total volume of oxygen in blood.

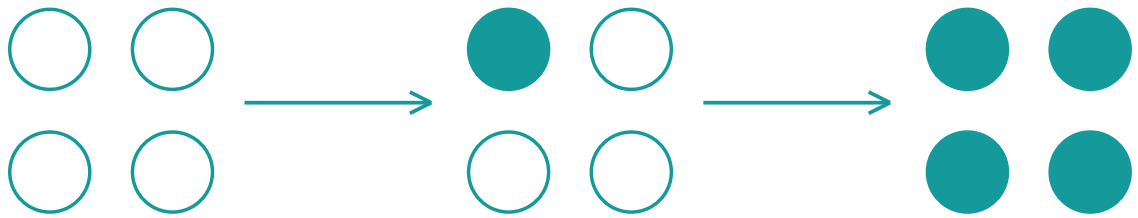
Axes and saturation: Pittman, Regulation of Tissue Oxygenation, chapter 4.
Oxygen binding: OpenStax Anatomy & Physiology 2e, section 22.5.

Scope: Cambridge Biology 9700 syllabus, section 8.2, outcome 4, p. 28.

Why the curve is S-shaped

Adult haemoglobin has four subunits, each with an oxygen-binding haem group. Binding at one site affects the others: this is positive cooperativity.

1. FIRST BINDING PROMOTES FURTHER BINDING



No oxygen bound | First oxygen binds | Fully saturated

Each circle is one binding site; filled means occupied by O_2. This simplified sequence omits intermediate occupancies and does not show the actual shape of the protein.

2. LOW pO_2: FEW SITES ARE OCCUPIED

Unoxygenated haemoglobin has relatively low oxygen affinity. At very low oxygen partial pressure, binding is limited, so the curve begins near the origin and initially rises slowly.

3. MIDDLE SECTION: COOPERATIVE BINDING

Oxygen binding changes haemoglobin's conformation, making further oxygen binding easier. Over the steep region, a relatively small rise in pO_2 produces a large rise in saturation. The sites do not behave independently.

At high pO_2, the curve levels off because most sites are already occupied. Further increases add little to percentage saturation. The plateau reflects a finite number of binding sites, not a halt in circulation or oxygen exchange.

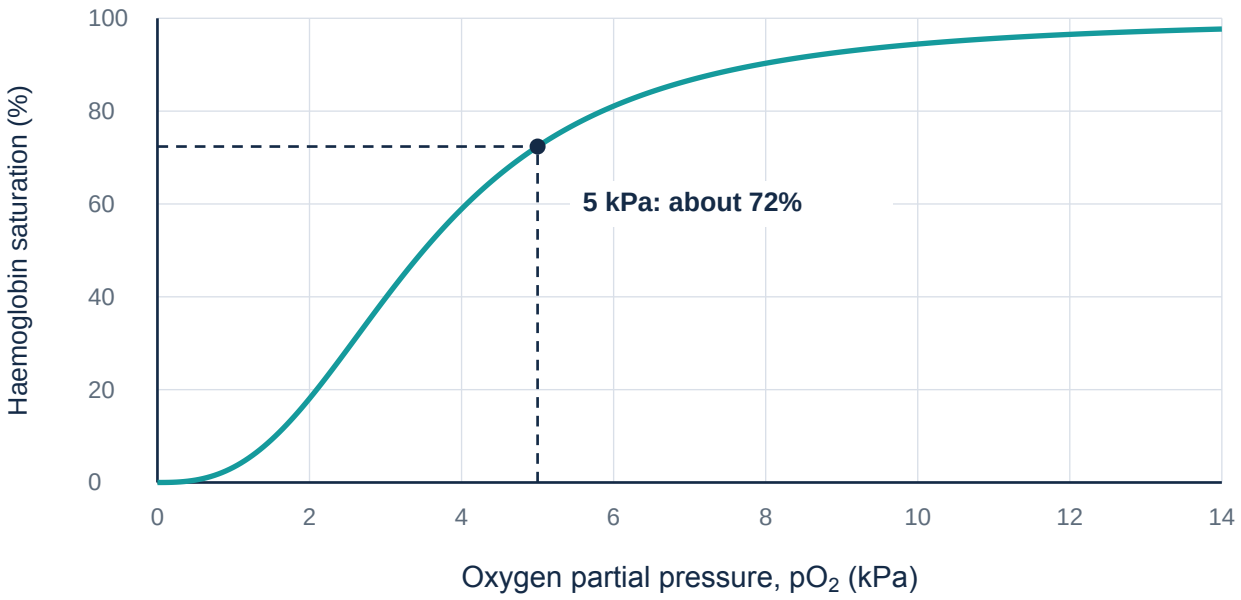
Cooperativity and finite binding sites: OpenStax Anatomy & Physiology 2e, section 22.5.
Sigmoid curve and affinity: StatPearls, Oxyhemoglobin Dissociation Curve.

Scope: Cambridge Biology 9700 syllabus, section 8.2, outcome 4, p. 28.

Read values without mixing variables

Start with the variable given in a question. Locate it on its axis, move to the curve, and then read the other axis. Keep pressure units and percentage saturation separate.

1. READ UP TO THE CURVE, THEN ACROSS



Illustrative model, not measured data: a Hill curve with exponent 2.7 and 50% saturation at 3.5 kPa. Values are for graph-reading practice; conditions affect real curves.

2. READ EITHER DIRECTION

For 5 kPa, move vertically up from the x-axis to the curve, then horizontally to the y-axis: about 72% on this model. If given saturation instead, start on the y-axis and reverse the steps. At 50% saturation this model gives 3.5 kPa.

3. SATURATION COUNTS OCCUPIED SITES

12 occupied sites out of 16 available sites = 75% saturation

A sample average does not mean every haemoglobin molecule has the same number of oxygen molecules bound. More haemoglobin can increase total oxygen content without changing the percentage saturation.

Saturation versus oxygen content and illustrative model: Pittman, chapter 4.
Reading the dissociation relationship: StatPearls, Oxyhemoglobin Dissociation Curve.

Scope: Cambridge Biology 9700 syllabus, section 8.2, outcome 4, p. 28.