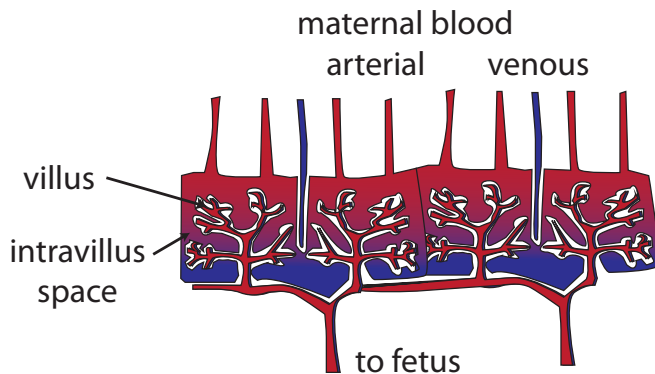


anatomy



physics

gas exchange is by passive diffusion
dependent on Fick's law

$$\text{Diffusion} \propto \frac{\text{Area}}{\text{Thickness}} \cdot \text{Diffusion constant (concentration gradient)}$$

thus diffusion is dependent on
membrane characteristics
thickness and area
gas characteristics (diffusion constant)
solubility and the square root of the molecular weight
the concentration gradient
between the two membranes

physiology

membrane characteristics improve at the end of pregnancy
thinning to 3.5 μm (although still less than the lung 0.5 μm)
increased surface area 15 m^2 (although still less than the lung which is 50-70 m^2)

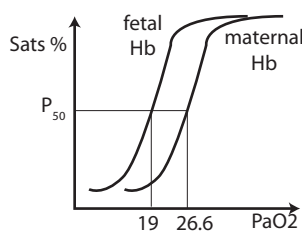
gas characteristics

CO₂ is much more soluble (20 times) therefore it requires less of a concentration gradient
CO₂ rapidly diffuses due to its solubility, the double haldane effect, lower maternal pCO₂

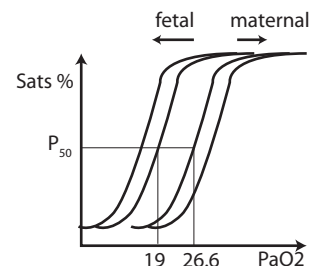
the concentration gradient

is increased by several unique characteristics
demonstrated using the Hb-O₂ dissociation curve

normal dissociation curves for fetal and maternal Hb



the double bohr effect due to the diffusion of CO₂ changing the pH increased in fetal decreased in maternal



fetal Hb has a left shifted curve which enables carry more O₂ at lower partial pressures
the double bohr effect

CO₂ diffuses rapidly to the maternal circulation making it slightly acidic (right shift)
fetal blood becomes alkalotic resulting in the fetal curve moving further left
this facilitates further O₂ shifting from maternal to fetal blood