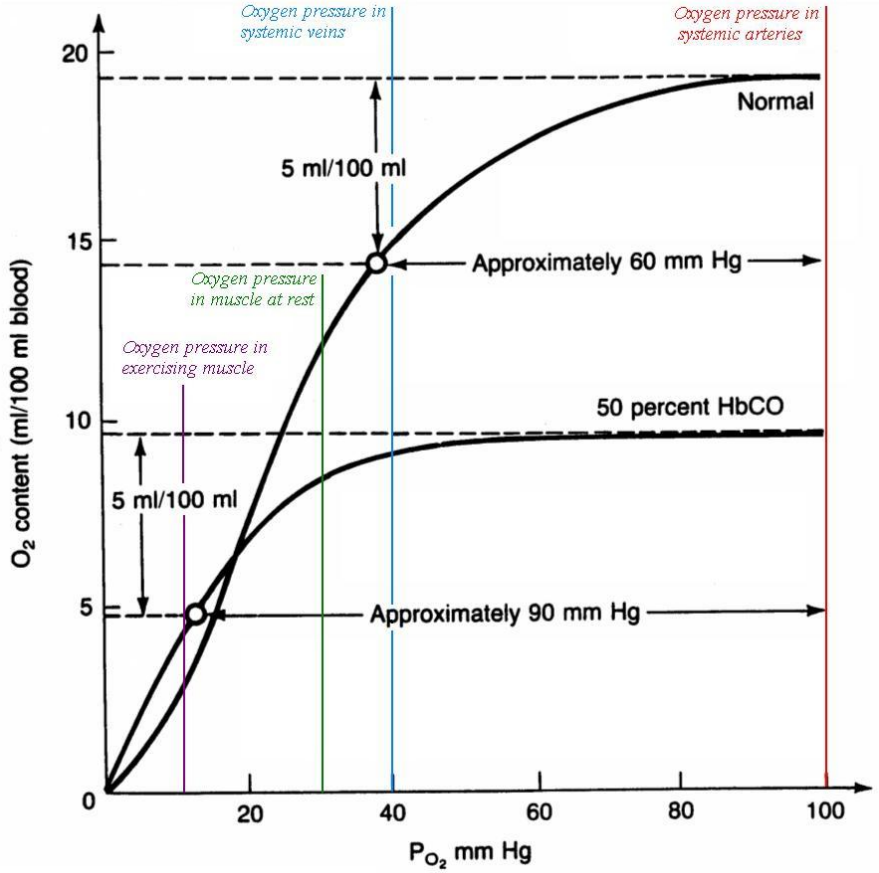
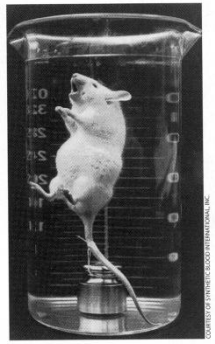


F5.8. Saturation curve of blood with air and CO. Atmospheric air has 160 mm Hg of O_2.
Modified from Williams and Burson, 1985.

5.2.1.1. CO Interference with Oxygen Transport

Carbon monoxide binds Hb 225 times more strongly than O_2, as shown in the equation below, where M = 225 and the Ps represent partial pressures. In the presence of CO, therefore, less Hb is available to carry oxygen.

$$\frac{[Hb-CO]}{[Hb-O_2]} = M\frac{P_{CO}}{P_{O_2}}$$



F5.9. A rat breathing perfluorocarbons.

0.07 % CO can be lethal. Another effect of CO at 0.1 % is to alter the Dissociation-Saturation curve of Hb, as shown in F5.8. Saturation of Hb with CO inhibits oxygen transport by binding less oxygen more tightly: in the graph, a depression of 90 mm Hg in oxygen pressure (as opposed to 60 mm) is necessary to release 5 ml of oxygen.
The symptoms of CO poisoning are low blood pressure, fainting, dizziness, headache, weakness and nausea.

In a Toxicokinetic application, **canaries** have been used as warning devices to protect the health of miners, since coal mines are likely to contain pockets of CO. A canary is small, its metabolism is high, and it has a high breathing rate. Therefore, it will be in equilibrium with CO much faster than a human, and should serve as a warning for humans to leave the tunnel. However, the binding of CO to canary Hb is only 110 times (not 225) stronger than that of oxygen. Because of this, it is possible that the miner will die before the canary, usefully warning the canary to get out of the mine shaft. Therefore canaries as a warning device are only effective above 0.2 % CO.
Because the CO_2 chemo-receptors that increase respiration rate are not affected by CO poisoning, the lack of O_2 concentration into the tissues is not noticed until too late.