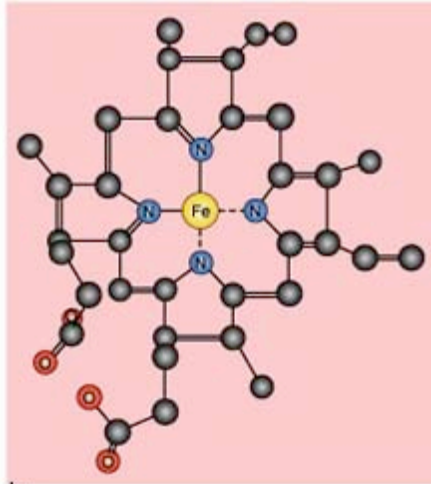
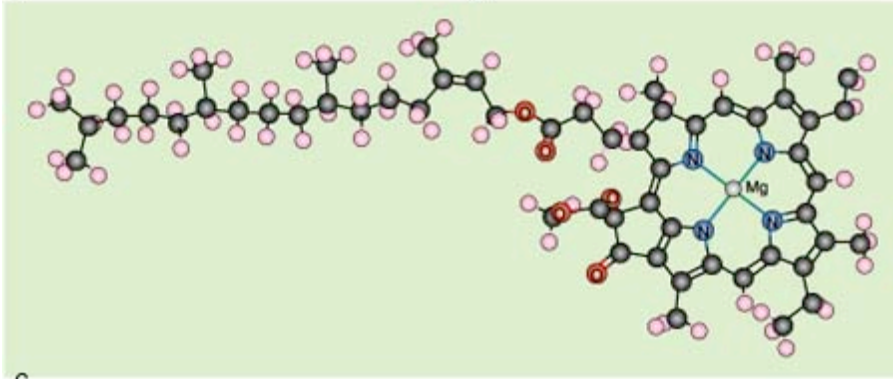


a



b



c

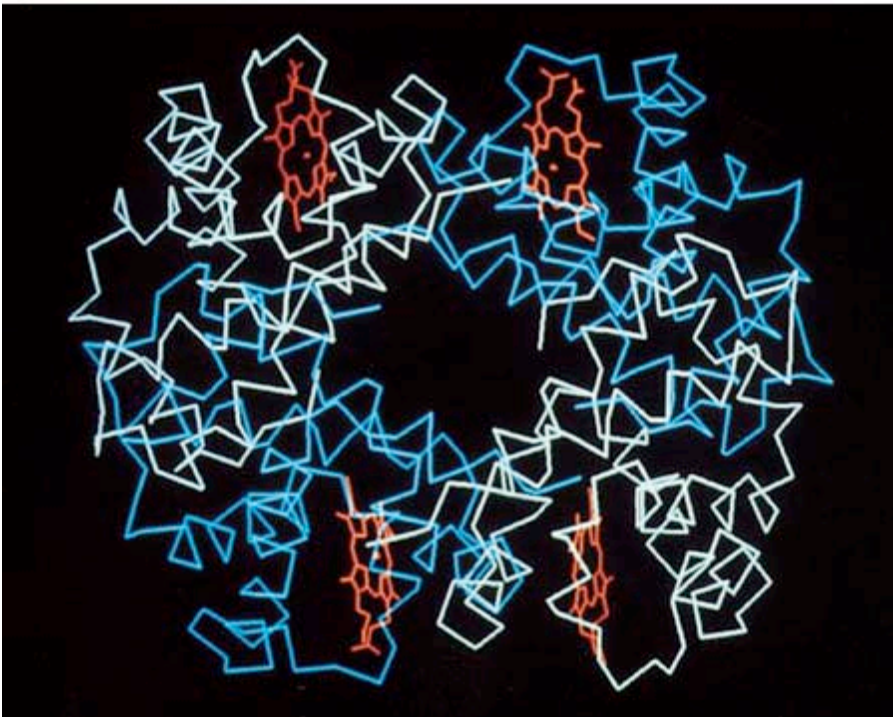


Figure 2. Molecular cages called *porphyrin rings* are at the heart of the hemoglobins and related proteins. The basic structure of this cage can be seen in protoporphyrin IX (*a*). When the porphyrin contains an iron ion in the center, the structure is the red-colored heme (*b*). Heme (*red*) is embedded in globin proteins to form hemoglobins, as they are here in this computer-generated model of hemoglobin (*d*). When the porphyrin contains a magnesium ion in the center, the compound is called chlorophyll (*c*). Chlorophyll, which gives plants their green color, is embedded in proteins in the membranes of chloroplasts, the structures within plant cells at which photosynthesis takes place. Porphyrins are thought to be very old, predating the appearance of molecular oxygen on earth between one and two billion years ago. It is possible that these early porphyrins participated in the sulfur-based metabolism of early single-celled life forms before being co-opted into pathways used in oxygen-based metabolism.

Michelle Hoffman and Aaron Cox; Michelle Hoffman and Aaron Cox; Edward Roberts and Aaron Cox; Image of hemoglobin molecule courtesy of Max Perutz.