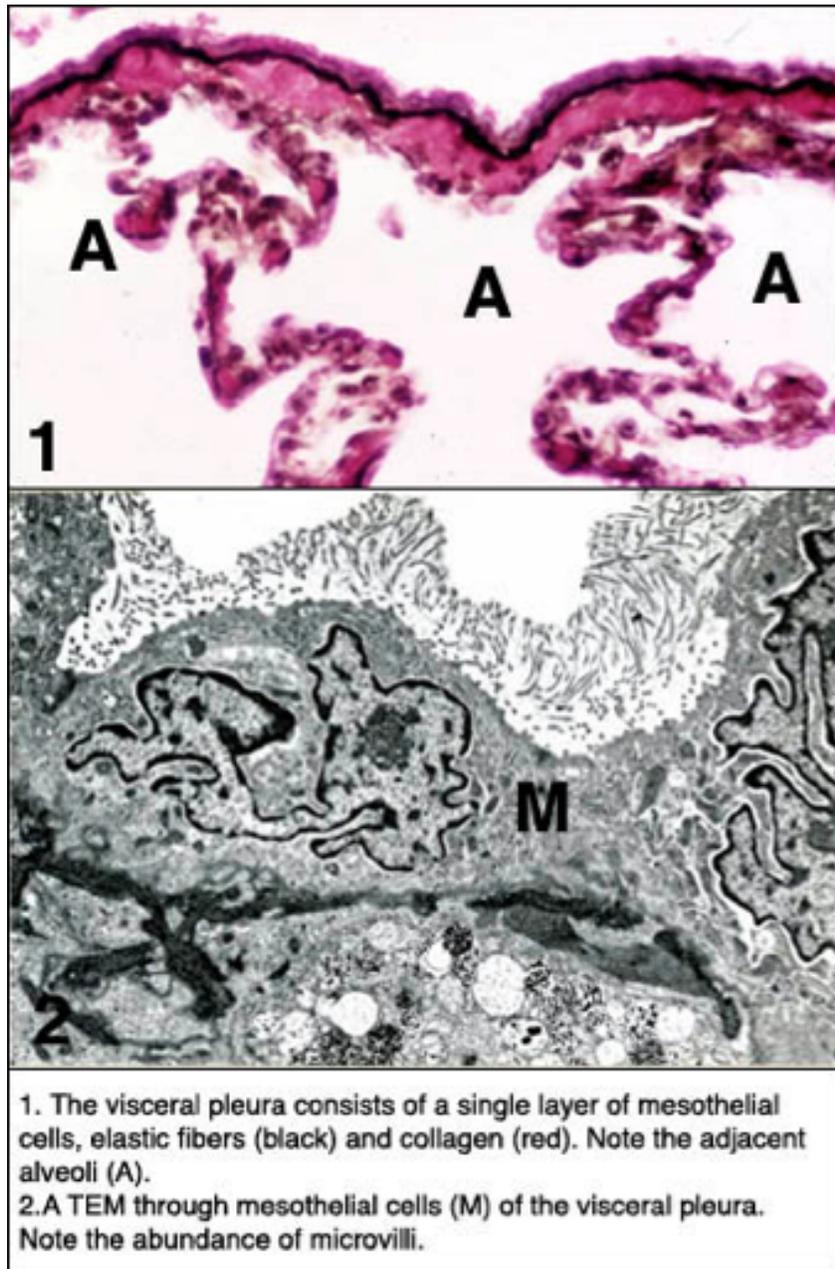


## Pleura



The pleura are thin membranes made up of collagenous and elastic fibers, covered by a single layer of mesothelial cells. The layer lining the wall of the thoracic cavity is the parietal pleura, which reflects from the thoracic wall onto the surface of the lungs, where it becomes the visceral pleura. The pleura secrete a small amount of fluid between the two layers of covering/lining mesothelium to permit a friction-free movement. Although the two pleurae easily glide over one another, their separation is strongly resisted. As a result the lungs adhere tightly to the interior of the thoracic wall and expand and shrink as the volume of the thoracic cavity increases or decreases during respiration. Contraction of the diaphragm increases the vertical dimension (superior inferior diameter) of the thoracic cavity and contraction of the intercostal and other accessory respiratory muscles raise and elevate the ribs expanding the anterior-

posterior diameter of the thorax. Contraction of intercostal muscles results in the rotation of the second to the seventh rib arches at the costosternal and costovertebral joints. This movement referred to as the bucket-handle movement describes the elevation of the ribs and the eversion of their lower borders which results in an increase in the transverse diameter of the thorax. The sternal ends of the ribs and costal cartilages also are elevated thrusting the sternum forward to increase the anterior posterior diameter of the thorax. This movement is described as the pump-handle movement. In addition, the intercostal muscles also act to stiffen the thoracic wall to prevent changes in the shape of the thorax as a result of negative pressure created by contraction of the diaphragm. As the volume within the thoracic cavity enlarges the pressure within the pleural cavity and lungs decreases. As a result, air flows into the respiratory system from the surrounding atmosphere. Expiration is primarily a passive process. As the relaxed diaphragm moves superiorly and intercostal muscles relax, the rib cage is compressed decreasing the volume of the thorax and lungs. Forced expiration utilizes the abdominal muscles. Simultaneously the elastic tissue within the lungs recoils increasing the pressure within the lungs forcing air out of the lungs.

### **Control of Respiratory Rate**

The primary respiratory center for regulating respiration is located in the reticular formation of the medulla (rostral ventrolateral medulla) of the brain. This region functions as a pacemaker the neurons of which generate a basic respiratory rhythm. This basic rhythm can be modified by input from other regions of the brain as well as input from receptors that sense changes in the chemistry of the arterial blood. The chemoreceptors respond to rising levels of carbon dioxide, falling levels of oxygen and changes in pH. The chemoreceptors sensitive to these changes are separated into two major categories: central chemoreceptors, located primarily in the medulla of the brain; and peripheral chemoreceptors located in the carotid and aortic bodies. Carotid bodies send their sensory information to the medulla primarily through the glossopharyngeal nerves whereas the aortic bodies convey their information through the vagus nerves.