

acid–base balance in the blood, and cardiovascular activity in the infant. Factors that interfere with this normal transition or that interfere with fetal **oxygenation** (including conditions such as hypoxemia, hypercapnia, and acidosis) affect the fetus's adjustment to extrauterine life.

Immediate Adjustments

Respiratory System

The most critical and immediate physiologic change required of newborns is the onset of breathing. The stimuli that help initiate the first breath are primarily chemical and thermal. **Chemical factors** in the blood (low oxygen, high carbon dioxide, and low pH) initiate impulses that excite the respiratory center in the medulla. The primary **thermal stimulus** is the sudden chilling of the infant, who leaves a warm environment and enters a relatively cooler atmosphere. This abrupt change in temperature excites sensory impulses in the skin that are transmitted to the respiratory center.

Tactile stimulation may assist in initiating respiration. Descent through the birth canal and normal handling during delivery help stimulate respiration in uncompromised infants. Acceptable methods of tactile stimulation include tapping or flicking the soles of the feet or gently rubbing the newborn's back, trunk, or extremities. Slapping the newborn's buttocks or back is a harmful technique and should not be done. Prolonged tactile stimulation, beyond one or two taps or flicks to the soles of the feet or rubbing the back once or twice, can waste precious time in the event of respiratory difficulty and can cause additional damage in infants who have become hypoxemic before or during the birth process ([American Academy of Pediatrics, Committee on Infectious Diseases, 2011](#)).

The initial entry of air into the lungs is opposed by the surface tension of the fluid that filled the fetal lungs and the alveoli. Some lung fluid is removed during the normal forces of labor and delivery. As the chest emerges from the birth canal, fluid is squeezed from the lungs through the nose and mouth. After complete delivery of the chest, brisk recoil of the thorax occurs, and air enters the upper airway to replace the lost fluid. Remaining lung fluid is absorbed by the pulmonary capillaries and lymphatic