

- In larger insect species, tracheae alternatively open and close as many muscles contract and relax

Ventilation of the Bird Lung

- 4 steps to ventilation:
 - 1) Inhale - air flows through tracheae into posterior air sacs
 - 2) Exhale - lungs fill w/ air from posterior air sacs (posterior of lungs: parabronchi)
 - 3) Next inhalation - anterior air sacs fill w/ air
 - 4) Next exhalation - anterior air sacs empty out, air moves out to atmosphere

Open Circulatory System

- Hemolymph (fluid equivalent to blood in invertebrates - pumped throughout body in open vessels)
- Open system characteristic of invertebrates
 - 1) Heart pumps hemolymph into vessels that empty into open, fluid-filled spaces
 - 2) Heart internal pressure drops & hemolymph moves into heart through holes in surface
 - 3) Body movements help move hemolymph to/from heart
 - 4) Hemolymph is under low pressure, best for sedentary organisms w/o high O₂ demands
- Crustaceans are an **exception**: they use small vessels to send hemolymph to tissues w/ high O₂ demand

Vertebrate Lungs

- Tracheae carries inhaled air to narrow tubes called bronchi ; bronchi branches off into bronchioles