

# Study Guide — HBS Unit 3: Adventure Awaits (End-of-Unit Test)

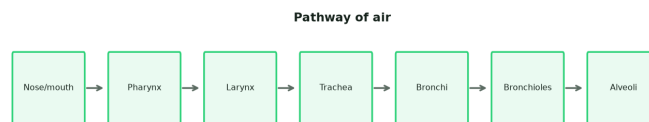
Human Body Systems · Unit 3 — Adventure Awaits · Modeled on the PLTW Guided Review format

## Vocabulary to know cold

| Term                  | Definition                                                                                               |
|-----------------------|----------------------------------------------------------------------------------------------------------|
| Alveoli               | Air sacs in the lungs where oxygen and carbon dioxide diffuse across the respiratory membrane.           |
| Diaphragm             | Dome-shaped muscle that contracts to draw air into the lungs during inhalation.                          |
| Bronchi               | The two large airways branching from the trachea into each lung.                                         |
| Diffusion             | Passive movement of molecules (like O <sub>2</sub> and CO <sub>2</sub> ) from high to low concentration. |
| -pnea                 | Suffix for breathing: apnea (none), dyspnea (difficult), tachypnea (rapid).                              |
| pulmon/o              | Combining form for lung (pulmonary, pulmonologist).                                                      |
| cardi/o               | Combining form for heart (cardiac, cardiology, tachycardia).                                             |
| vas/o                 | Combining form for vessel (vasodilation, vasoconstriction).                                              |
| Cardiac output        | Volume of blood pumped per minute; equals heart rate x stroke volume.                                    |
| VO <sub>2</sub>       | Rate of oxygen consumption; rises with exercise intensity.                                               |
| Aerobic metabolism    | Energy (ATP) production that uses oxygen; dominant at lower exercise intensity.                          |
| Lactic acid (lactate) | Byproduct of anaerobic metabolism when oxygen supply is limited.                                         |
| Distal / Proximal     | Directional terms: distal = farther from the trunk; proximal = closer to the trunk.                      |

## Worked examples (follow the reasoning)

**Example 1.** Order the pathway of air from outside the body to the site of gas exchange.



- Air enters at the nose or mouth.
- It passes through the pharynx (throat), then the larynx (voice box).
- It travels down the trachea (windpipe).
- The trachea splits into the right and left bronchi.
- Bronchi branch into smaller bronchioles.
- Bronchioles end in alveoli, where gas exchange with blood occurs.

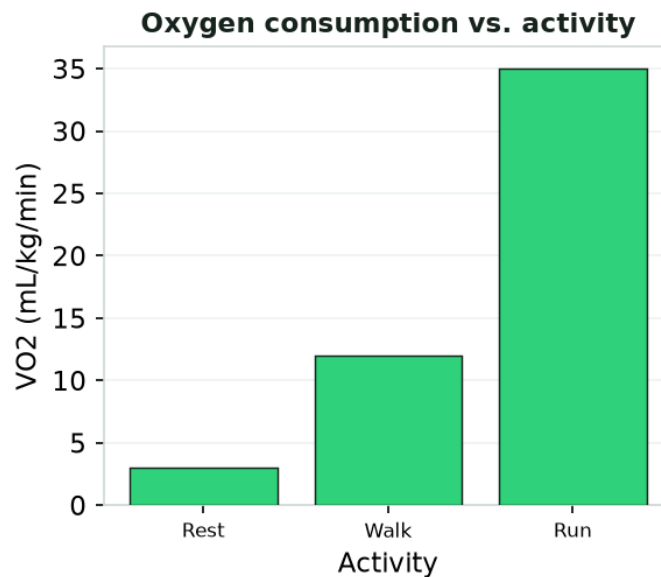
**Answer:** Nose/mouth -> pharynx -> larynx -> trachea -> bronchi -> bronchioles -> alveoli.

**Example 2.** A runner's heart rate is 60 bpm at rest with a stroke volume of 70 mL, and during a sprint rises to 180 bpm with a stroke volume of 120 mL. Show how cardiac output changes.

- Use the formula: cardiac output = heart rate x stroke volume.
- At rest: 60 bpm x 70 mL = 4,200 mL/min (about 4.2 L/min).
- During the sprint: 180 bpm x 120 mL = 21,600 mL/min (about 21.6 L/min).
- Compare: cardiac output increases roughly 5-fold to meet the muscles' oxygen demand.

**Answer:** Cardiac output rises from ~4.2 L/min at rest to ~21.6 L/min during the sprint.

**Example 3.** Explain why VO<sub>2</sub> (oxygen consumption) increases when a person goes from walking to running.



- Running requires more muscular work than walking.
- Muscles produce ATP mainly through aerobic respiration, which consumes oxygen.
- More work means more ATP demand, so cells use more oxygen.
- Breathing and heart rate increase to deliver that oxygen, raising measured VO<sub>2</sub>.

**Answer:** Higher intensity demands more ATP, so muscles consume more oxygen and VO<sub>2</sub> increases.

### Practice questions (with reasoning)

1. Gas exchange in the lungs occurs by diffusion at the:

- A. Trachea
- B. Bronchi
- C. Alveoli
- D. Larynx

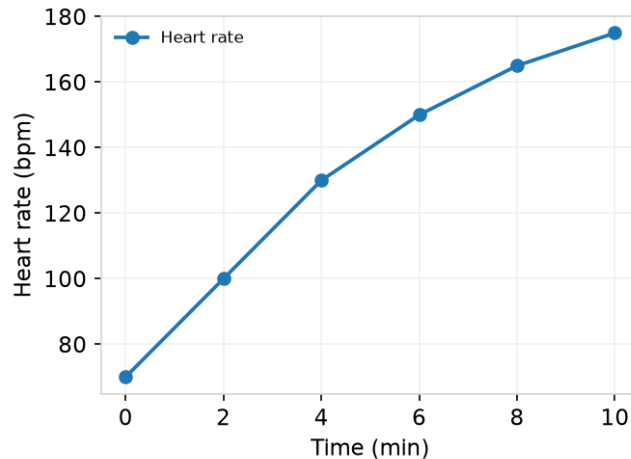
**Answer:** C. Alveoli provide thin-walled surface area for O<sub>2</sub> and CO<sub>2</sub> to diffuse with blood.

2. The word 'dyspnea' refers to breathing that is:

- A. Rapid
- B. Difficult or labored
- C. Absent
- D. Slow

**Answer:** B. dys- (difficult) + -pnea (breathing) = labored breathing.

3. As exercise intensity rises, cardiac output increases because:



- A. Heart rate and stroke volume both rise
- B. The heart shrinks
- C. Blood stops flowing
- D. Vessels close off

**Answer: A.** Cardiac output =  $HR \times SV$ ; both increase with exercise to deliver more oxygen.

4. SPIRAL (Unit 1): In anatomical terms, the elbow is \_\_\_\_ to the wrist.

- A. Distal
- B. Proximal
- C. Anterior
- D. Medial

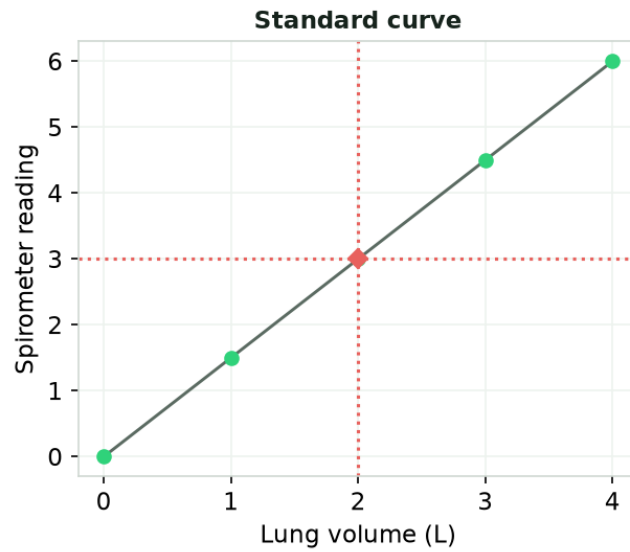
**Answer: B.** The elbow is closer to the trunk than the wrist, so it is proximal to the wrist.

5. SPIRAL (Unit 1): Which muscle type makes up the heart wall?

- A. Skeletal
- B. Smooth
- C. Cardiac
- D. Adipose

**Answer: C.** Cardiac muscle is the involuntary, striated muscle of the heart (myocardium).

6. A spirometer is calibrated with known lung volumes that give the readings plotted below. An unknown breath produces a reading of 3.0. Using the standard curve, what is the unknown volume?



- A. 1 L
- B. 2 L
- C. 3 L
- D. 4.5 L

**Answer: B.** The curve rises 1.5 reading units per liter, so a reading of 3.0 corresponds to  $3.0 / 1.5 = 2$  L.