

Lesson Plan

The Respiratory System

Goals of the Lesson

Cognitive: The student will gain an understanding of the structure and function of the respiratory system, including inhalation and exhalation, the processes of internal and external gas exchange, how gases are transported in the blood, and the regulation of these processes in the brain stem. The student will also understand the effects of a number of diseases that target the respiratory tract, and some of the instrumentation used to treat these diseases.

Psychomotor: N/A

Affective: N/A

Learning Objectives (LO)

- LO-1 Define respiration, and describe its four phases.
- LO-2 Name and describe all the structures of the respiratory system.
- LO-3 Explain the mechanism for pulmonary ventilation.
- LO-4 Discuss the processes of internal and external gas exchange.
- LO-5 List the ways in which oxygen and carbon dioxide are transported in the blood.
- LO-6 Describe factors that control ventilation.
- LO-7 Describe the negative feedback loop regulating arterial CO₂ levels.
- LO-8 Describe normal and altered breathing patterns.
- LO-9 Compare hyperventilation and hypoventilation, and cite three possible results of hypoventilation.
- LO-10 Describe the causes and treatments of common respiratory disorders.
- LO-11 List six types of respiratory infections.
- LO-12 Identify the diseases involved in chronic obstructive pulmonary disease (COPD).
- LO-13 Describe some disorders that involve the pleura.
- LO-14 Describe common techniques and equipment used to treat respiratory disorders.
- LO-15 Show how word parts are used to build words related to respiration.

Assessments

Module Quiz

Section 6 Exam

Final Exam

Estimated Time on Task

| Learning Content | Pre-Test | Practice Activities | Quiz | TOTAL |
|------------------|----------|---------------------|--------|--------|
| 159 min | 10 min | 40 min | 10 min | 3.7 hr |

Learning Objective 1

Define respiration, and describe its four phases.

Outline

Instructor's Notes

- Respiration: Process of obtaining oxygen from environment and delivering it to cells
- Four phases of respiration
 - Pulmonary ventilation
 - External gas exchange
 - Gas transport in the blood
 - Internal gas exchange

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Discuss the definition of *respiration*, including *cellular respiration*, as well as the four phases outlined in the module.

Web Resources

[Florida Hospital Kissimmee Lung Anatomy Animation](#)

Learning Objective 2

Name and describe all the structures of the respiratory system.

Outline

- Respiratory system is an intricate arrangement of spaces and passageways.
- Several major structures:
 - Nasal cavities
 - Pharynx (throat): muscular
 - Nasopharynx
 - Oropharynx
 - Pharynx—opens into larynx
 - Larynx (voice box)
 - Between pharynx and trachea
 - Trachea (windpipe)
 - The bronchi
 - The lungs—two, side by side
 - Left lung
 - Indentation accommodates the heart
 - Divided into two lobes
 - Right lung
 - Divided into three lobes
 - Bronchioles
 - Alveoli

Instructor's Notes

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Use sheep organs to examine the structure of the larynx or lower passageways and lungs.

Materials

Sheep's larynx, partial sheep pluck, freeze-dried sheep's lungs

Web Resources

[Anatomy and Physiology of the Respiratory System](#)
[Clinical Anatomy – Nasal Cavity and Sinuses](#)

Learning Objective 3

Explain the mechanism for pulmonary ventilation.

Outline

- Pulmonary ventilation
 - Inhalation (inspiration) is active phase.
 - Diaphragm and intercostal muscles contract to enlarge thoracic cavity, lowering pressure in lungs.
 - Air enters lung to equalize pressure.
 - Exhalation (expiration) is passive phase.
 - Diaphragm and intercostals relax, making thoracic cavity smaller; gas in smaller area, higher pressure.
 - Air leaves lung down the pressure gradient.
- Affected by compliance: ease of expansion.

Instructor's Notes

Resources and Activities

Resources

PPT Slides, animation, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Using a lung model, demonstrate to students that their lungs are not active participants in breathing.

Or students can measure their own lung volumes and those of classmates using spirometers.

Materials

Functional lung model

Economical simulation of mechanics of breathing using elastic bands and salad tongs

9L Student Wet Spirometer

Web Resources

[Respiratory System 9, Lung Volumes Spirogram](#)

Learning Objective 4

Discuss the processes of internal and external gas exchange.

Outline

- Gas exchange
 - Principle governing external exchange is diffusion
 - Oxygen and carbon dioxide
 - Gases diffuse down pressure gradients across the respiratory membrane
 - Pressure expressed in mm Hg
 - Pressure of each gas in a mixture denoted as partial pressure (P + subscript)
- External exchange
 - Gases move between alveoli and capillary blood
 - Movement based on pressures of the two gases
- Internal exchange
 - Gases move between blood and tissues
 - Movement depends on pressures of the two gases

Instructor's Notes

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Remind students that the partial pressures on both sides of the membrane/capillary wall are relevant to the magnitude of gas exchange. Thus, blood gas partial pressures are equally important as alveolar partial pressures. Ask students to predict the effect of changes in alveolar, blood, and tissue gas partial pressures on internal/external gas exchange. For instance:

- Increased alveolar oxygen (increased external exchange)
- Increased pulmonary capillary oxygen (decreased external exchange)
- Increased metabolic activity, reducing tissue oxygen partial pressure (increased internal exchange)

Web Resources

[Respiration Gas Exchange](#)

Learning Objective 5

List the ways in which oxygen and carbon dioxide are transported in the blood.

Outline

Instructor's Notes

- 98% of oxygen diffused into capillary blood binds to hemoglobin in red blood cells.
- Oxygen releases from hemoglobin as partial pressure of oxygen drops in tissues.
- Hemoglobin also transports CO_2 , acts as buffer by binding hydrogen ions.
- CO_2 in blood is converted to carbonic acid by carbonic anhydrase enzyme in red blood cells.
- Carbonic acid converts to bicarbonate and hydrogen ion, which diffuse out of the cell into plasma.

Resources and Activities

Resources

PPT Slides, Animation, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Web Resources

[Respiratory System: \$\text{CO}_2\$ Transport](#)

Learning Objective 6

Describe factors that control ventilation.

Outline

- Central nervous control
 - Control center is located in medulla and pons of brain stem.
 - Motor nerve fibers extend into spinal cord.
 - Fibers extend through phrenic nerve to diaphragm.
 - Chemoreceptors act as sensors.
 1. Located on either side of the brain stem near the medullary respiratory center
 2. Peripheral receptors located in neck and aortic arch
 - Respiratory center in the medulla acts as control center.
 - Ventilatory muscles are effectors.
- Other factors
 - Stimulation of pain receptors
 - Emotional response
 - Mechanoreceptors in joints and muscles responding to change of position

Instructor's Notes

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Students may believe that each breath is stimulated by an increase in carbon dioxide. Instructors can deal with this misconception by mentioning that it takes about 30 seconds for the respiratory control center to respond to a change in arterial carbon dioxide levels. (We obviously breathe more frequently than that.)

Have the students count their respiratory rate for 1 minute.

Learning Objective 7

Describe the negative feedback loop regulating arterial CO₂ levels.

Outline

Instructor's Notes

- Feedback loop maintains relatively constant blood gas levels in arterial blood
 - Process
 1. Receptors respond to CO₂ level in circulating blood.
 2. Gas dissolves in medullary interstitial fluid and separates into hydrogen ion and bicarbonate ion.
 3. Presence of hydrogen ion stimulates the chemoreceptors.
 4. Hypercapnia causes respiratory center to send more signals to the ventilator muscle; this increases rate and depth of breathing to eliminate more CO₂ and return to normal arterial levels.

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Before discussing this objective: Ask students to hold their breath until they feel the stimulus to breathe. Ask them why they needed to breathe. Highlight the special characteristics of the hemoglobin molecule.

Learning Objective 8

Describe normal and altered breathing patterns.

Outline

- Normal breathing patterns are measured in breaths per minute.
 - Adults: 12 to 20/min
 - Children: 20 to 40/min
 - Infants: more than 40/min
- Abnormal breathing patterns
 - Hyperpnea
 - Hypopnea
 - Tachypnea
 - Apnea
 - Dyspnea
 - Orthopnea
 - Kussmaul respiration
 - Cheyne–Stokes respiration
- Results of inadequate breathing
 - Cyanosis
 - Hypoxia
 - Hypoxemia
 - Suffocation

Instructor's Notes

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Ask students to determine their respiration rates during relaxation and physical exercise.

Discuss the effect of the reduction in atmospheric oxygen one experiences at high altitudes.

Web Resources

[Cheyne Stokes Breathing Pattern](#)

Learning Objective 9

Compare hyperventilation and hypoventilation, and cite three possible results of hypoventilation.

Outline

Instructor's Notes

- Hyperventilation: increased amount of air in alveoli, decreases CO₂ in blood
 - Results in hypocapnia
 - Increases blood pH
 - Causes alkalosis—excess alkalinity of fluids
- Hypoventilation: insufficient air in alveoli
 - Increases blood CO₂ concentration
 - Lowers blood pH
 - Causes acidosis—excess acidity of fluids

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Ask students to determine their respiration rates during physical exercise.

Ask students to compare and contrast hyperventilation, hyperpnea, and tachypnea. Note that the breathing center initiates hyperpnea when normal ventilation is not sufficient, so it restores homeostasis. Hyperventilation, conversely, takes the body away from homeostasis.

Discuss the effect of the reduction in atmospheric oxygen one experiences at high altitudes.

Web Resources

[Hyperventilation and Hypoventilation](#)

Learning Objective 10

Describe the causes and treatments of common respiratory disorders.

Outline

- Sinusitis
 - Inflammation from chronic sinus infections.
- Polyps
 - Tumor or growth formations that may cause airway obstruction
- Deviated septum
 - Nasal septum that is markedly to one side
 - One nasal space may be smaller
- Epistaxis
 - Nose bleed
 - Most common cause is injury to the mucus membranes

Instructor's Notes

Resources and Activities

Resources

PPT Slides Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Ask students to share experiences of having sinusitis, a deviated septum, or epistaxis.

Learning Objective 11

List six types of respiratory infections.

Outline

- Common cold
- Respiratory syncytial virus (RSV)
- Croup
- Influenza
- Pneumonia
- Tuberculosis
- Hay fever
- Asthma
- Sudden infant death syndrome (SIDS)
- Acute respiratory distress syndrome
- Surfactant deficiency disorder
- Cancer

Instructor's Notes

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Ask students to investigate the causes and the treatments of respiratory diseases.

Web Resources

[Pneumonia](#)

[Asthma](#)

[Cancer](#)

Learning Objective 12

Identify the diseases involved in chronic obstructive pulmonary disease (COPD).

Outline

Instructor's Notes

- Chronic obstructive pulmonary disease (COPD) or chronic obstructive lung disease (COLD)
 - Chronic bronchitis
 - Airway linings chronically inflamed
 - Emphysema
 - Dilation and eventual destruction of alveoli
 - Dyspnea
 - Difficulty exhaling

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

COPD lungs can be compared to an old pair of socks or a dry cleaner bag. The sock/bag can be easily stretched and inflated because of the high compliance. However, the sock/bag does not readily spring back to its original size (passive exhalation), because it is not very elastic.

Materials

Pair of socks

Web Resources

[COPD](#)

[Struggle to Breathe](#)

Learning Objective 13

Describe some disorders that involve the pleura.

Outline

- Disorders involving the pleura
 - Pleurisy
 - Inflammation of pleura
 - Pneumothorax
 - Air in pleural space
 - Hemothorax
 - Blood in pleural space
 - Thoracentesis treatment, fluid drained from pleural space with large needle

Instructor's Notes

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Web Resources

[Pneumothorax](#)

Learning Objective 14

Describe common techniques and equipment used to treat respiratory disorders.

Outline

Instructor's Notes

- Equipment for respiratory treatment
 - Bronchoscope
 - Oxygen therapy equipment
 - Suction apparatus
 - Tracheostomy tube
 - Artificial respiration apparatuses
 - Cardiopulmonary resuscitation (CPR) compressions
 - Heimlich maneuver—abdominal thrusts or back blows clear airway of any object lodged there

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Tour a hospital to learn more about the techniques and equipment used by respiratory therapists.

Discuss the phenomenon of oxygen bars. Discuss whether oxygen-supplemented waters offer any benefit to the consumer.

Learning Objective 15

Show how word parts are used to build words related to respiration.

Outline

Instructor's Notes

- Respiratory system structure: nasopharynx, oropharynx, laryngeal pharynx, pleura
 - nas/o (nose)
 - or/o (mouth)
 - laryng/o (larynx)
 - pleur/o (side, rib)
- Process of respiration: spirometer, hypercapnia, hypopnea, orthopnea
 - spir/o (breathing)
 - capn/o (carbon dioxide)
 - -pnea (breathing)
 - orth/o- (straight)
- Respiratory disorders: pneumonia, rhinitis, atelectasis, pneumothorax, thoracentesis
 - pneumon/o (lung)
 - rhin/o (nose)
 - atel/o (incomplete)
 - pneum/o (air, gas)
 - centesis (tapping, perforation)

Resources and Activities

Resources

PPT Slides, Pre-Test, Practice Activities, Module Quiz, Section 6 Exam, Final Exam

Activities

Ask students to make up their own words, based on the word parts provided in the Word Anatomy Chart at the ends of the chapters up to this point. The rest of the class could try to guess the meaning.
