Bergen Community College

Division of Health Professions

Respiratory Care Program

RSP-222, Cardio-Pulmonary Anatomy & Physiology

Date of Most Recent Syllabus Revision:

Semester and Year:

Course and Section Number:

Meeting Times and Locations:

Instructor:

Office Location:

Phone:

Departmental Secretary:

Office Hours:

Email Address:

Course Description

Lecture hours and credits: 2 lecture hours, 2 credits

Prerequisites: BIO-109, RSP-110, RSP-119, and RSP-121. Co-requisites: RSP-210, RSP-220, and RSP-225

Course Description: This course is a study of physiologic mechanisms of the cardiopulmonary system, including a review of the anatomy of the pulmonary and circulating systems; ventilatory physics / mechanics, gas diffusion, physiology of internal and external respiration, oxygen transport, carbon dioxide transport and elimination, ventilation / perfusion relationships; and the neurological control of ventilation.

Student Learning Objectives: As a result of meeting the requirements in this course the student will:

Anatomy of the Respiratory System

1. Differentiate between the structures of the upper and lower airways.
2. Describe how the upper and lower airways differ in their ability to filter, humidify, and warm inspired gas.
3. List the goals of artificial airway humidification when natural humidification mechanisms are bypassed.
4. Describe what keeps the large cartilaginous airways and small non-cartilaginous airways patent.
5. Identify the difference between conducting airways and the respiratory zones of the lung.
6. Describe how the various lung clearance mechanisms function and interact.
7. Describe and score a patient with a difficult airway.

8. Explain why the pleural membranes normally have a subatmospheric pressure between them and how this subatmospheric pressure is related to lung volume.
9. Explain the functional differences between primary and accessory muscles of ventilation.

Control of Ventilation

10. Understand the neural control of the lungs and thoracic musculature.
11. Explain how the medullary respiratory center generates the basic breathing pattern.
12. Describe how the medullary respiratory neurons and pontine centers interact.
13. Explain how various reflexes and receptors affect ventilation, including the Hering-Breuer inflation reflex, J-receptors, proprioceptors, and muscle spindles.
14. Show how carbon dioxide indirectly stimulates the medullary chemoreceptors.
15. Explain why high arterial carbon dioxide pressure more readily stimulates the central chemoreceptors than high arterial levels of metabolically produced fixed acid.
16. Explain why PaCO2 is a more appropriate controller of ventilation than arterial oxygen pressure.
17. Explain why hypoxemia plays a more important role in regulating ventilation in patients with chronically high PaCO2 than patients with normal PaCO2.
18. Describe two mechanisms whereby oxygen administration might induce hypercapnia in patients who have severe chronic obstructive pulmonary disease.
19. Explain how PaCO2 affects the cerebral circulation and intracranial pressure.

Mechanics of Ventilation

20. Describe the pressure gradients that determine lung volume and airflow rate into and out of the lung.
21. List factors that cause lung compliance and airway resistance to change.
22. Describe how surface tension and pulmonary surfactant influence lung compliance, inflation pressure, alveolar stability, and work of breathing.
23. Explain what causes the lung's pressure-volume curve to exhibit hysteresis.
24. Explain how lung compliance and airway resistance determine passive emptying and filling rates of the lung during breathing.
25. Explain how work of breathing, respiratory muscular strength, and respiratory muscular fatigue are clinically assessed.
26. Explain how to use pressure-volume and time-pressure curves to distinguish between elastic and frictional forces that oppose lung inflation.

Oxygen Equilibrium and Transport

27. Describe how the blood takes up, transports, and releases oxygen.
28. Explain the difference between arterial and venous oxygen contents and how they are affected by oxygen consumption and cardiac output.
29. Show how oxygen content, oxygen saturation, oxygen partial pressure (PO2), and hemoglobin concentration are interrelated.
30. Explain why the sigmoid-shaped oxyhemoglobin equilibrium curve is physiologically advantageous.
31. Describe how various factors affect the affinity of hemoglobin for oxygen.
32. Explain why the value of P50 is a marker of hemoglobin's affinity for oxygen.
33. Explain why changes in cardiac output affect the difference between arterial and mixed venous oxygen contents.

34. Explain why arterial oxygen partial pressure (PaO_2) and arterial oxygen saturation (SaO_2) are inadequate by themselves for the assessment of oxygenation.

Carbon Dioxide Equilibrium and Transport

35. Explain how arterial PCO_2, dissolved CO_2, carbonic acid, and alveolar ventilation are interrelated.
36. Explain why blood CO_2 levels play a role in the body's acid–base balance.
37. Describe how CO_2 is transported in different ways in the blood plasma and erythrocytes.
38. Explain how hemoglobin in the erythrocyte helps generate plasma bicarbonate ions.
39. Explain how the body's CO_2 production rate can be equal to the body's CO_2 elimination rate in states of normal ventilation, hypoventilation, and hyperventilation.

Gas Diffusion

40. Calculate the partial pressures of gases under dry and 100% relative humidity conditions.
41. Use the alveolar gas equation.
42. Explain why the respiratory exchange ratio affects the calculation of alveolar oxygen pressure (PAO_2).
43. Identify the factors that affect diffusion, as illustrated by Fick's law.
44. Use Graham's law and Henry's law to explain the differences in oxygen (O_2) and carbon dioxide (CO_2) diffusion rates in the lung.
45. Explain why O_2 transfer from lung to blood is perfusion limited but carbon monoxide (CO) transfer is diffusion limited.

Ventilation and Pulmonary Blood Flow

46. Explain how minute ventilation, alveolar ventilation, and dead space ventilation are interrelated.
47. Explain why alveolar ventilation affects $PaCO_2$.
48. Compare and contrast three pulmonary blood flow zones.
49. Explain how external mechanical and internal physiological changes can convert one pulmonary blood flow zone to a different type of zone.
50. Explain why the match between blood flow and ventilation in an upright individual is different in the lung base than in the lung apex.
51. Explain why intrapulmonary shunt responds poorly to oxygen therapy.
52. Differentiate between the effects absolute shunt and absolute dead space have on arterial blood gases.
53. Use the classic physiological shunt equation to calculate the fraction of shunted cardiac output.

Functional Anatomy of the Cardiovascular System

54. Describe the gross anatomy and function of each structure of the heart.
55. Explain how the atria, ventricles, and heart valves work together to pump blood through the pulmonary and systemic circulations.
56. Explain how the specialized cardiac conduction system coordinates the synchronized contraction and relaxation of the atria and ventricles.
57. Explain how pumping action and arterial elasticity work together to produce continuous blood flow.

58. Explain how different mechanisms work to control the distribution of blood flow through systemic capillary beds.

Cardiac Electrophysiology

59. Explain the timing and sequence of all mechanical events in the cardiac cycle.
60. Explain the nature of the electrochemical events that cause the cardiac muscle fiber to depolarize spontaneously.
61. Interpret and name the cardiac events associated with the electrocardiogram.
62. Understand the relationship of electrical and mechanical events during a cardiac cycle.
63. Be able to identify the components of a normal ECG tracing.
64. Describe the mechanisms whereby various drugs affect cardiac contractility and excitability (vasopressors, inotropes, and antiarrhythmic drugs).
65. Understand routes of administering medications during cardiac arrest.

Course Content

This course will provide a foundational understanding of the respiratory and circulatory system. This will be completed through understanding the various pulmonary and cardiac (hemodynamic) tests and procedures performed.

Special Features of the Course

MoodleRooms is used to enhance the interaction with the student. The student will need to access MoodleRooms regularly throughout the week to review postings, emails, or other important class material.

Poll Everywhere is used within the course's lecture presentations. Certain cellular phone providers may charge for text messages sent to and from the Poll Everywhere system. Bergen Community College, the Respiratory Care Program or faculty are not responsible for any charges. A student may avoid charges by downloading the free application from Google Play or Apple Store, or use the link https://pollev.com on any browser.

Course Texts and Other Study Materials

- Required
  - Respiratory Care Anatomy and Physiology Foundations for Clinical Practice, 4th ed., Beachey – ISBN: 9780323416375
- Recommended
  - Workbook for Respiratory Care Anatomy and Physiology Foundations for Clinical Practice, 3rd ed., Beachey – ISBN: 978-0-323-08586-1
  - Egan's Fundamentals of Respiratory Care, 11th ed., Kacmarek, ISBN: 9780323341363

Examination Requirements

Examinations:

Examinations could require multiple choice, short answer, mathematical calculation, or brief essay questions that address topics related to the readings, lectures and class discussions covered.

Cardiac Arrhythmia Presentation:

The students will present, as a group, their assigned electrocardiography rhythm. Each cardiac arrhythmia can include the 6-step interpretation method (or discussion about why it cannot be interpreted), a patient's physical signs and symptoms, and applicable treatments. Grading will be in the following categories: organization, quality of content, response to questions, and presentation. The grading rubric and weight distribution is posted on Moodle.

Grading Policy

Grade Determinations

Quizzes (4)	Points
Quiz 1	25
Quiz 2	25
Quiz 3	35
Quiz 4	25
Cardiac Arrhythmia Presentation	40
Total points	150

Grading:

A	Student must show superior theoretical knowledge.	93 – 100
B+	Student must merit high quality classroom work and theoretical knowledge.	88 – 92.9
B	Student must show above average knowledge.	83 – 87.9
C+	Student meets the standard of achievement with reasonable knowledge.	78 – 82.9
F	Student fails to meet minimum course standards and objectives.	<78
	Incomplete – Student has not completed course requirements.	

Late work or Examinations:

Late work and make up examinations will be penalized with a grade being no greater than seventy-eight percent (78%). Exams are scheduled during the last two weeks of the semester but before the last scheduled class. All late coursework must be completed before the last scheduled

class. If an exam is not completed before the last scheduled day of class, a grade of zero (0) will be recorded.

Attendance / Academic Integrity Policy

Academic Integrity:

Academic dishonesty is a serious violation of BCC policy and personal ethics and will be treated as such if reason for suspicion should arise. Students should be careful to avoid plagiarism, falsification, and compliance. Academic dishonesty also includes cheating on examinations. Refer to the BCC college catalog for additional information.

BCC Attendance Policy:

All students are expected to attend punctually every scheduled meeting of each course in which they are registered. Attendance and lateness policies and sanctions are to be determined by the instructor for each section of each course. These will be established in writing on the individual course outline. Attendance will be kept by the instructor for administrative and counseling purposes.

Course Attendance Policy:

Attendance and punctuality at all class sessions is required and will be factored into the student's overall final grade. Attendance for classroom lecture and lab will be factored into the total grade for the course. For every absence from classroom lecture or lab, 1 point will be deducted from the total grade for the course. If the student is late by 10 minutes for the lecture or lab, 0.5 points will be deducted from the total grade.

Departmental Policy Statements

1. Acceptable quality of work and mature behavior is expected from every student at all times. Students are regarded as professionals and are expected to conduct themselves accordingly.
2. High standards of professional performance demand that students maintain good academic progress throughout their course of study in the program.
3. Students demonstrating chronic tardiness or absenteeism will be placed on academic warning or probation, and may be subjected to termination from the program.
4. Absence from a class during a scheduled exam will be subject to the policy of the instructor for that specific course. If the student is going to miss a scheduled exam it is expected that the student will contact the instructor ahead of time by email or phone to the department office.
5. All students are required to adhere to the policies and procedures of the school as outlined in the college catalogue.
6. Additional department policies are in the Student Policies and Procedures Manual.

Student and Faculty Support Services

1. The program faculty maintains office hours for counseling and is available to provide tutorial assistance to students.
2. Students must make appointments in advance to meet with the respective instructors.
3. Students may also obtain assistance from the College Tutoring Center. Appointments must be made in advance through this center.
4. The College has a personal counseling center for those students who may need personal assistance. Appointments are made directly through this center.
5. Any problems, concerns, or questions should be directed to the course instructor or the student's advisor.
6. Statement on Civility
    a. Refer to the Standards of Conduct Subsection found in the Student Judicial Affairs Policies & Procedures Section found in the Student Handbook.
7. Academic Integrity
    a. Refer to the Academic Integrity Subsection; found in the Academic Regulations, Academic Policies Section found in the Academic Policies & Regulations Area of the College Catalog.
8. Other possible College, Divisional, or Departmental Policy Statements to be referenced
    a. ADA statement.
    b. Sexual Harassment statement.
    c. Statement on acceptable use of BCC technology.
    d. Statement on the purpose and value of faculty office hours.
9. Student and Faculty Support Services
    a. List support services, e.g., the Writing Center, the Math Lab, the Tutorial Center, Online Writing Lab (OWL), Office of Specialized Services, etc.
10. BCC Library
    a. The Sidney Silverman Library is committed to providing a quiet, welcoming, respectful atmosphere conducive to study and research in an environment that is comfortable, clean, and safe. The use of the library will be beneficial in providing resources on researching topic information, citation styles, finding current articles among many other media services available.