# Course Syllabus
## RC 241 Arterial Blood Gas Analysis

<table>
<thead>
<tr>
<th>Class Hours:</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory Hours:</td>
<td>0</td>
</tr>
<tr>
<td>Credit Hours:</td>
<td>2</td>
</tr>
</tbody>
</table>

**Instructor**  
Mickey Rountree  
Office ext 4770  
Office 2085  
Email mickey.rountree@chattanoogastate.edu

**Course Description:**  
An introduction to the collection, analysis and interpretation of arterial blood gases. Includes detailed study of the pathophysiology of oxygenation and ventilation and associated disorders.

**Entry Level Standards:**  
Current standing in the respiratory care program

**Prerequisites:**  
RC 111, RC 142

**Co Requisites:**  
RC 143 RC 112

**Textbooks:**  
Clinical Blood Gases, William J. Malley

**Class Web Site:**  
RC 241 on Elearn

**Library Usage:**  
All students are required to have internet access to check Elearn for course updates and materials. Internet access is available in the RC Lab and the HSC Resource room.

**Internet Access:**  
All students are required to have internet access to check Elearn for course updates and materials. Internet access is available in the RC Lab and the HSC Resource room.

**Presentation**  
1. Lecture  
2. Audiovisual aids, including transparencies and power point  
3. Demonstration and student use of equipment  
4. Handouts  
5. Student discussion in classroom

**Specific Evaluation Process**  
**Missed Class Tests** - student is responsible for taking all tests as scheduled. Any missed test must be made up as soon as possible, and the make-up test may differ from the original. Acceptable excuses for missing test are jury duty, court subpoena, and illness with a doctors excuse. Personal and family emergencies will be reviewed on a case by case basis.

**Testing sources**  
Test material will come from text reading, hand outs and class lectures and activities. The student is responsible for material covered in text but not presented in class.

**Academic dishonesty**  
See program policy handbook

---

RC 241 Syllabus
| **Misc** | The use calculators during class or testing will be at the instructor=s discretion. Under no conditions will preprogramed calculators be allowed. The TI calculators are ok if not preprogramed before test. The instructor may provide basic calculators for test taking. The use of tape recorders and other recording devises will be at the instructors discretion. No beepers or cellular phone calls during class |
| **Grade Calculation** | Four tests plus a comprehensive final. Each test is 20 of the final grade |
| **Course Testing, Grading And Retesting** | Five tests including the final which is comprehensive. Each test is 20% of final average. Each test must be passed with a minimum grade of 75. Any test below a 75 must be retaken within seven days to achieve a 75 or better. Either the original grade or 70%, whichever is higher will be used to calculate the class average. Only one retest will be given for an exam. Only two tests may be retaken during the semester. A 75 on every test (or retake) is required to pass the course, regardless of overall average. A grade less than 70 on the final exam will result in a grade of D or F; there will be no retest on the final. Students making a score less than 75% on a retest or making less than 75% on a third examination will not be eligible to continue in this class or associated laboratory. Makeup exams will be given without penalty only for excused absence (doctor=s excuse for illness, subpoena, jury duty, court orders). Unexcused makeup test grades will be reduced 5 points per day that the testing center is available until made up. See testing center schedule and note that Saturday is an available day. See your Respiratory Care Handbook for further details regarding retention and testing policies. |
| **Class Attendance :** | Punctual attendance at all scheduled classes is expected. Final grade will be reduced 1% for each unexcused absence (acceptable excuses are doctor=s excuse for illness, subpoena, jury duty, court orders) after the second absence. Final grade will be reduced 2% for each tardiness (>5 min) after the second tardiness. |
| **Office Hours** | Monday and Friday 10:00-11:00 12:00-3:00 |
| **Disabilities Statement** | Students who have educational, psychological, and/or physical disabilities may be eligible for accommodations that provide equal access to educational |

RC 241 Syllabus
programs and activities at Chattanooga State. These students should notify the instructor immediately, and should contact Disabilities Support Services within the first two weeks of the semester in order to discuss individual needs. The student must provide documentation of the disability so that reasonable accommodations can be requested in a timely manner. All students are expected to fulfill essential course requirements in order to receive a passing grade in a class, with or without reasonable accommodations.

**Disruptive Students:** The term "classroom disruption" means - student behavior that a reasonable person would view as substantially or repeatedly interfering with the activities of a class. A student who persists in disrupting a class will be directed by the faculty member to leave the classroom for the remainder of the class period. The student will be told the reason(s) for such action and given an opportunity to discuss the matter with the faculty member as soon as practical. The faculty member will promptly consult with the division dean and the college judicial officer. If a disruption is serious, and other reasonable measures have failed, the class may be adjourned, and the campus police summoned. Unauthorized use of any electronic device constitutes a disturbance. Also, if a student is concerned about the conduct of another student, he or she should please see the teacher, department head, or division dean.

**Affirmative Action:** Students who feel that he or she has not received equal access to educational programming should contact the college affirmative action officer.

**Changes:** This syllabus can be changed at the discretion of the instructor with written or oral notice.

---

**Respiratory Care Program Student Learning Outcomes (PSLO)**

**PSLO 1)** Graduates of the Respiratory Care program will show the ability to interpret, comprehend, apply and evaluate patient data and clinical information relative to their role as an Advanced-Level Respiratory Therapist. CSLO 1-10

**PSLO 2)** Graduates of the Respiratory Care program will demonstrate the proficiency in all the mechanical and physical skills necessary to fulfill their role as an Advanced-Level Respiratory Therapist.

**PSLO 3)** Graduates of the Respiratory Care program will demonstrate behaviors and attitudes consistent with professional and employer expectations for an Advanced-Level Respiratory Therapist.

**PSLO 4)** Graduates of the Respiratory Care program will provide the community with qualified
individuals who can meet current and future needs of the workplace as respiratory therapists.

**Course Student Learning Outcomes**

CSLO 1. Know proper arterial blood gas sample collection and handling.
CSLO 2. Know how the body maintains acid/base homeostasis.
CSLO 3. Be able to interpret ABG results and apply to patient management.
CSLO 4. Know how modern blood gas analyzers function and how to perform and interpret quality control procedures.
CSLO 5. Know common sources of error in blood gas analysis.
CSLO 6. Know how oxygen and carbon dioxide are transported in the body.
CSLO 7. Know causes of acid/base disturbances and how they are treated.
CSLO 8. Know how to measure intrapulmonary shunting and how to treat it.
CSLO 9. Know how pulse oximeters and capnometers work and how to interpret data.
CSLO 10. Know how hypoxemia and shunting are treated.

**Instructional Indicators:**

For CSLO 1:
The RC student will:
1) Know hazards, complications and relative contraindications for ABG puncture.
2) Know and be able to locate and palpate the common arterial puncture sites.
3) Know proper sample handling and anticoagulation.
4) Know steps in performing arterial puncture.
5) Know steps in performing sampling from arterial line. Pay particular attention to the direction of the stopcock in arterial lines.
6) Know steps in performing capillary sampling and how values differ from arterial.

For CSLO 2:
The RC student will:
1) Know the definition of acids, bases, and pH and given a hydrogen concentration, be able to calculate pH.
2) Know the buffer systems in the body, their chemical function, and the difference between open and closed systems.
3) Know the hydrolysis reaction that occurs when CO2 is dissolved in water.
4) Know how to calculate $V_E$, $V_A$, and how PaCO2 is related to VCO2 and ventilation.
5) Know the six ways CO2 is transported and how the major portion is transported.
6) Know the steps that occur when Hb releases oxygen, combines with H+, CO2 enters the RBC, including the chloride shift.
7) Be able to convert from PaCO2 to meq/L of H2CO3 or to vol% of CO2.

RC 241 Syllabus
8) Know the role of the renal system in acid/base regulation.
9) Know the definition of weak and strong bases and acids and the definition of a buffer. Know how a buffer is able to minimize pH changes. Know what the pK is and the definition of open and closed buffer systems.

For CSLO 3:
The RC student will:
1) Know normal values for PaCO2, PaO2, pH, HCO3-, B.E., SaO2.
2) Know how normal values are derived. Know percent of values within 2 and 3 standard deviations.
3) Develop a systematic approach to evaluating ABG results for acid/base balance and oxygenation.
4) Know the clinical manifestations of acidosis and alkalosis.
5) Know definitions and degrees of severity for acidemia, alkalemia and normal.
6) Be able to assess respiratory acid/base balance by inspecting PaCO2 and pH; be able to assess metabolic acid/base balance by inspecting HCO3- or BE and pH.
7) Be able to determine primary acid/base disorder and degree of compensation if any.
8) Be able to recognize mixed alkalosis and mixed acidosis.
9) Know alternative acid/base terminology such as alveolar hyperventilation and ventilatory failure and acute, chronic, compensated and uncompensated.
10) Know adult ranges for hyperoxemia, mild, moderate and severe hypoxemia.
11) Know the four major acid/base abnormalities and how the body compensates for each.

For CSLO 4:
The RC student will:
1) Know structure and function of Sanz, Clark and Severinghaus electrodes.
2) Know causes of analytic and preanalytic error.
3) Know definitions of accuracy and precision. Know accuracy of electrodes.
4) Know slope and balance definitions and values. (also called one and two point calibration)
5) Know the basics of quality control. Standards used, calculation of standard deviation, and plotting on Levy Jennings chart.
6) Know what percent of a population would be included in +/- 1, 2 and 3 standard deviations.
7) Know what to do for out of control values.
8) Know definition for shifts, trends, random or dispersion error and be able to identify on a Levy-Jennings chart.
9) Give the formula for standard deviation and a set of numbers, be able to calculate mean, standard deviation and coefficient of variation.

For CSLO 5:
The RC student will:
1) Know the potential errors in sample handling and how each would affect values.
2) Know how ABG values change with changes in temperature.
3) Know which type of heparin is used to anticoagulate ABG samples and what effect too much heparin would cause.
4) Know and be able to work gas law problems. Dalton's, Boyle's, Gay Lussac=s, combined, Charles, Henry's.
5) Be able to convert from °F to °C and back.
6) Know units of pressure and be able to convert from Cm H2O to mm Hg and back.
7) Know symbols used in describing gases.
8) Know normal water vapor pressure at 37°C.
9) Know effects on barometric pressure of altitude.

For CSLO 6:
The RC student will:
1) Know the expected relationship between PaO2 and FiO2.
2) Know the role of saturation, HB, and cardiac output in oxygenation.
3) Know definitions for Partial pressure and Fractional concentration
4) Know the quantitative relationship between changes in PaCO2 and pH.
5) Know the three steps in tissue oxygenation (external respiration, gas transport, internal respiration)
6) Know the importance of the interaction between the cardiovascular and pulmonary systems.
7) Know the differences and relations between hypoxia and hypoxemia and know the 4 types of hypoxia.
8) Know control of ventilation, central and peripheral.
9) Know distribution of ventilation, perfusion, and V/Q relationships and West's three zone model.
10) Know the primary and compensatory causes of abnormal distribution of ventilation.
12) Know the definition of deadspace, the three types, normal values, and how to calculate it. Know the relationship between ventilation, PaCO2 and deadspace and VCO2.
13) Know the factors that affect diffusion, such as time, thickness, driving pressure and surface area.
14) Know solubility of oxygen in plasma.
15) Know oxyhemoglobin dissociation curve, be able to draw and label points, what factors shift it.
16) Know normal male and female values for Hb and RBC's.
17) Be able to calculate CaO2, CvO2, CcO2 and calculate Ca-vO2 and know normal values.
18) Know the relationship between cardiac output and CvO2 and Ca-v O2.
19) Be able to calculate oxygen extraction ratio and know normal values.
20) Know definition of cyanosis and how to calculate if a person would show cyanosis.
21) Know the types of hemoglobin variants (COHb, MetHb, Fetal Hb, etc) and how they affect O2 transport.
22) Know the components of internal respiration.

23) Know what respiratory quotient is, how to calculate it, normal values, and how it varies with diet.

24) Know the Henderson-Hasselbalch equation and be able to solve for pH given PaCO2 and HCO3-

25) Be able to calculate the expected HCO3- given the rule of 8 chart, and be able to determine if the results are consistent.

26) Be able to use the modified H-H equation to calculate [H+] and to evaluate results for consistency.

27) Be able to calculate total CO2 given [HCO3-] and PaCO2.

28) Know the expected relationship between FIO2 and PaO2 and how to apply it to evaluate ABG results for consistency.

29) Know how to use SpO2 to evaluate ABG results for consistency.

30) Know the differences in HCO3-, standard bicarbonate, T40 standard bicarbonate, BE and BE(ecf) and which indices are most reliable with alterations in PaCO2. (T40 standard bicarbonate, and BE(ecf)) and why they are more accurate.

For CSLO 7:
The RC student will:

1) Know how the kidney produces urine.

2) Know the major fluid compartments and how fluid is distributed.

3) Know the major anions and cations and whether they are more concentrated intracellularly or intravascularly.

4) Know how sodium and HCO3 is reabsorbed and how K+ and H+ are excreted in the kidney.

5) Know how the renin-angiotensin system functions.

6) Know how diuretics work and their effects on electrolytes and acid/base balance.

7) Know how H+ is buffered in the urine.

8) Know how acid/base imbalances affect K+.

9) Know how hypokalemia, hypochloremia, hyperkalemia, and hyperchloremia affect acid/base balance.

10) Know how to calculate the anion gap, what is normal and what causes abnormal values.

11) Know the common causes of respiratory acidosis.

12) Know the common causes of respiratory alkalosis.

13) Know the common causes of metabolic acidosis.

14) Know the common causes of metabolic alkalosis.

15) Be able to interpret a blood gas using the acid/base map.

16) Know how ABG=s in a COPD patient may make interpretation difficult. In particular be aware of how hyperventilation, lactic acidosis, and acute hypercapnia will look superimposed on chronic CO2 retention.

17) Know the conditions that should cause you to suspect mixed acid/base disorders.

18) Know the difference between supportive and corrective treatment for acid/base disorders.

19) Know how and when to treat respiratory acidosis and alkalosis in both
spontaneously breathing and mechanically ventilated patients.

20) Know how and when to treat metabolic acidosis.
21) Know the indications, contraindications and dosage calculation for NaHCO3.
22) Be able to explain venous paradox and why arterial blood gases may not be useful in CPR and why NaHCO3 is contraindicated in CPR.
23) Know the uses of THAM and how to calculate the dosage.
24) Know how and when to treat metabolic alkalosis.

For CSLO 8:
The RC student will:
1) Know the definition of shunting, the three types, normal values, and how to calculate it. Know the indices used to indirectly assess shunting (PA-aO2, a/A ratio, PaO2/FIO2.)
3) Know the effects on oxygenation of Hb, metabolism, and distribution of perfusion
4) Know the shunt equation and be able to calculate a shunt,
5) Know the estimated shunt equations and the errors each introduces.
6) Be able to calculate PA-a O2, PaO2/PAO2, PaO2/FIO2, and PaO2/%O2. Know the limitations of each and what they assess.
7) Know effect of body positioning on C.O., airway closure and V/Q matching.
8) Know definition and mechanism of improvement of PEEP.
9) Know difference between threshold and flow resistors for providing PEEP.
10) Know indications, and hazards of PEEP.
11) Know definition optimal PEEP
12) Know definition and effects of auto-PEEP or occult PEEP and how to manage it.
13) Know the effects of CMV on oxygenation.

For CSLO 9:
The RC student will:
1) Know what end tidal CO2 is and how it compares to PtcO2.
2) Know the shape of a single breath capnogram.
3) Know the conditions that affect the gradient between end tidal and arterial CO2.
4) Know the technology (not specific wave lengths) used in capnometry and oximetry.
5) Know how oximetry differs from cooximetry, the difference between functional and fractional saturation, and how COHb and MetHb affect each.
6) Know how transcutaneous monitors work.
7) Know how transcutaneous monitors compare to arterial values in adults and infants.
8) Know how transcutaneous monitors sense changes in perfusion to underlying tissues.
9) Know the difference in O2 saturations determined by nomogram, oximetry, co-oximetry, and pulse oximetry.

RC 241 Syllabus
10) know the use of saturation to monitor for hypoxia.
11) Know the limitations of pulse oximetry.

For CSLO 10:
The RC student will:
1) Know how to diagnose and differentiate hypoxemia due to hypoventilation, intrapulmonary Shunting, shunt effect, and diffusion defect.
2) Know the signs and symptoms associated with hypoxemia.
3) Know the signs and symptoms associated with hypercapnia.
4) Know when hyperoxemia may be indicated.
5) Know the indications for oxygen therapy.
6) Know the mechanisms by which oxygen therapy may improve PaO2.
7) Know definition of high flow and low flow O2 systems and which devices are in each class.
8) Know the hazards of O2 therapy.
9) Know the goals of O2 therapy.
10) Know how to safely administer O2 to O2 sensitive COPD patients.
11) Know causes, signs and symptoms of CO2 narcosis.
12) Know normal Hb and RBC values for males and females.
13) Know the different types of anemia.
14) Know definition for:
  anisocytosis
  macrocytosis
  microcytosis
  poikilocytosis
  reticulocytes
  normoblasts
  MCH
15) Know the potential role of anemia in causing hypoxia.
16) Know normal and critical values for O2 delivery.
17) Know factors increase O2 uptake.
18) Know definition of covert hypoxia and diseases that cause it and consequences and treatment
19) Know how to measure C.O. and normal values.
20) Know how C.O. is indirectly assessed.
21) Know definition, signs and symptoms and causes of shock.
22) Know signs and symptoms of heart failure.
23) Know definition, signs and symptoms and treatment of hypovolemia.
24) Know what vascular tone is and factors that affect it.
25) Know normal values and causes of abnormal values for arterial BP, CVP, Pulmonary artery pressure, PCWP.
26) Know how PCWP can be used to differentiate types of shock and causes of pulmonary edema.
27) Know how shock is treated.
28) Know the role of lactate and lactate/pyruvate in diagnosing hypoxia.

RC 241 Syllabus
30) Know how the central chemoreceptors control ventilation.
31) Know how the peripheral chemoreceptors function, where they are and how they are stimulated.
32) Know how ventilation is affected by hypoxemia.
33) Know the role of the Hering-Bruer and J receptor reflexes.

Required Assessments:
- Test 1: PSLO 1, 4, CSLO 1, 2, 3
- Test 2: PSLO 1, 4, CSLO 4, 5
- Test 3: PSLO 1, 4, CSLO 6
- Test 4: PSLO 1, 4, CSLO 8, 10
- Test 5 (Comprehensive final): PSLO 1, 4, CSLO 9, 7

WEEK/UNIT/TOPIC

<table>
<thead>
<tr>
<th>1</th>
<th>Acid/base homeostasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Arterial blood gas classification</td>
</tr>
</tbody>
</table>
| 3 | Arterial blood gas classification  
Arterial blood gases sample collection |
| 4 | Test 1  
Blood gas sampling errors |
| 5 | Blood gas sampling errors  
Oxygenation and external respiration |
| 6 | Test 2  
Oxygen transport and internal respiration |
| 7 | Oxygen transport and internal respiration  
Accuracy check and metabolic acid/base indices |
| 8 | Assessment of hypoxemia and shunting |
| 9 | Test 3  
Treatment of hypoxemia and Shunting |
| 10 | Hypoxia: Assessment and intervention  
Regulation of acids, bases, and electrolytes |
| 11 | Regulation of acids, bases, and electrolytes  
Test 4 |
| 12 | Differential diagnosis of Acid/base disorders |
| 13 | Mixed acid/base disorders |
| 14 | Noninvasive blood gas monitoring |
| 15 | TEST 5 --FINAL EXAM - COMPREHENSIVE |
Student Acceptance Of Policies

I have read all of the policies contained in the syllabus for Respiratory Care (RC 111) and understand them and agree to abide by them.

Student Signature ________________________________
Date ____________________________

(tear this page out and return this page to the instructor)