

GMS 6470 | Adv. Respiration Physiology 1

Class Number: 14146

Instructor Information

Peter Sayeski

Course Details

Catalog Description: Covers a quantitative understanding of atmospheric, alveolar, and blood gas pressures, as well as quantitative understanding of oxygen carriage in blood and alterations in blood chemistry that result from changes in blood gases. Particularly, building an understanding of these concepts as defined in theoretical models as developed by theoretical physiologists.

Pre- and Co-Requisites: Prereq: GMS 6400C or (GMS 6440 and GMS 6402 and GMS 6474).

Credit Hours: 3

Course Fees: \$0.00

Additional Course Description

Covers a quantitative understanding of atmospheric, alveolar, and blood gas pressures, as well as quantitative understanding of oxygen carriage in blood and alterations in blood chemistry that result from changes in blood gases. Particular attention is paid to building an understanding of these concepts as defined in theoretical models as developed by theoretical physiologists. Concepts are taught using a combination of lectures, quantitative exercises based on theoretical physiology modeling, online literature critique, and a capstone research and scientific writing project. The quantitative exercises are designed to elucidate quantitative physiological concepts and to teach the students heuristic methodology for calculation of physiologic variables. The literature critique is designed to teach students to apply physiological knowledge in order to assess experimental data and their interpretation. The writing project is designed to teach students to understand complex physiological processes and to be able to write a scholarly short review of the subject with proper citations of the primary literature. Together, with Advanced Respiration 2 (GMS 64XX), the ultimate goal is for students to develop an understanding of quantitative theoretical models of respiration, to develop quantitative problem solving and critical thinking skills, and to develop skills for evaluation and reporting of concepts addressed in the peer-reviewed literature.

Recommended Materials

BERNE & LEVY PHYSIOLOGY, LATEST EDITION

ISBN: 9780323393942

Authors: BRUCE M. KOEPPEN & BRUCE A. STANTON

Publisher: ELSEVIER

Edition: 7TH

All Access: This course does not use UF All Access

Course Goals and Objectives

The overarching objective of this course is to provide a quantitative understanding of atmospheric, alveolar, and blood gas pressures, as well as quantitative understanding of oxygen carriage in blood and alterations in blood chemistry that result from changes in blood gases. This course will provide a quantitative understanding of the blood gases and acid-base physiology. Topics will be explored in detail using a quantitative approach, gaining an understanding of the physiology using theoretical (mathematical) physiological models. These objectives will be achieved using a combination of lectures, quantitative exercises, literature critique, and scientific writing.

Expectations and Student Learning Outcomes

Learning Objectives.

Upon completion of the course, students will be able to understand:

1. chemistry and physics of respiration
2. oxygen-hemoglobin dissociation
3. composition of alveolar gases
4. diffusion of blood gases

Methods of Evaluation

Grading Format

Assignments	Total Points	Percentage of Final Grade
Projects (quantitative exercises) (6)	10 each	60%
Term Paper	40	40%

Grading Scale

Grading Scale

Letter	Percentage Value
A	90 - 100%
A-	87 - 89.99%
B+	84 - 86.99%
B	81 - 83.99%
B-	78 - 80.99%
C+	75 - 77.99%
C	72 - 74.99%
C-	69 - 71.99%
D+	66 - 68.99%
D	63 - 65.99%
D-	60 - 62.99%

Letter	Percentage Value
E	0 - 59.99%

Course Schedule

The course is self-paced for asynchronous learners. It is comprised of 5 modules.

1. Module 1: The chemistry, physics, and analytical tools in respiration

- a. Lecture 1: Introduction to the course
- b. Lecture 2: Units of mass, pressure, and solubility
- c. Lecture 3: Solubility (Henry's Law)
 - i. Reading: Henry, W., Experiments on the quantity of gases absorbed by water, at different temperatures, and under different pressures, Philos. Trans. R. Soc. London, 93, 29-43, 1803.
 - ii. Reading: Christmas, K.M., Bassingthwaite, J.B. Equations for O₂ and CO₂ solubilities in saline and plasma: combining temperature and density dependences. J Appl Physiol 122: 1313–1320, 2017.
- d. Lecture 4: Steady State and Equilibrium: Fick Principle
 - i. Reading: G. Laszlo. Respiratory measurements of cardiac output from elegant idea to useful test. J. Appl. Physiol. 96:428-437, 2004.
- e. Lecture 5: Nonsteady-State: Rebreathing methodology
 - i. Reading: J.A. Franciosa. Evaluation of the CO₂ Rebreathing Cardiac Output Method In Seriously Ill Patients. Circulation 55:449-455, 1977.
- f. Lecture 6: Nonsteady-State: Thermodilution
 - i. Reading: G. Fegler. Measurement of cardiac output in anaesthetized animals by a thermodilution method. Q. J. Exp. Physiol. Cog. Med. Sci. 39:153-164, 1954.
 - ii. Reading: E.E. Argueta and D. Paniagua. Thermodilution cardiac output. Cardiology in Review 27:138-144, 2018.
 - iii. Reading: R.L. Berger, R.D. Weisel, L. Vito, R.C. Dennis, and H.B. Hechtman. Cardiac output measurement by thermodilution during cardiac operations. Ann. Thorac. Surg. 21:43-7, 1976.
 - iv. Reading: K. Pavek, D. Boska, and F.V. Selecky. Measurement of cardiac output by thermodilution with constant rate injection of indicator. Circ. Res. 15:311-319, 1964.
- g. Project 1: Calculation of cardiac output in the steady state.
- h. Project 2: Calculation of cardiac output in the non-steady state

2. Module 2: Hemoglobin

- a. Lecture 7: Modeling the oxygen-hemoglobin dissociation curve
 - i. Reading: Adair .S. The Hemoglobin System: VI, The Oxygen Dissociation Curve of Hemoglobin. J. Biol Chem. 63:529-545, 1925.
 - ii. Reading: Aberman A., J.M. Cavanilles, J. Trotter, D. Erbeck, M.H. Weil, and H. Shubin. An equation for the oxygen hemoglobin dissociation curve. J. Appl. Physiol. 35:570-571, 1973.
 - iii. Reading: Tien Y.-K., and R.A. Gabel. Prediction of PO₂ from SO₂ using the standard oxygen hemoglobin dissociation curve. J. Appl. Physiol. 42:985-987, 1977.
 - iv. Reading: Severinghaus J. Simple, accurate equations for human blood O₂ dissociation computations. J. Appl. Physiol. 46:599-602, 1979.

b. Lecture 8: Fetal hemoglobin

- i. Reading: Hellegers, A.E., Meschia G., Prystowsky H., Wolkoff A.S., and Barron D.H. A comparison of the oxygen dissociation curves of the bloods of maternal and fetal goats at various pHs. *J. Physiol.* 44: 215-221, 1959.
- ii. Reading: Darling R.C., C.A. Smith, E. Asmussen, and F.M. Cohen. Some properties of human fetal and maternal blood. *J. Clin. Invest.* 20:739-747, 1941.

c. Lecture 9: Physiological modification of hemoglobin affinity (The Bohr Effect)

- i. Reading: Bohr, C., Hasselbalch, K., and Krogh A. Concerning a Biologically Important Relationship - The Influence of the Carbon Dioxide Content of Blood on its Oxygen Binding. *Skand. Arch. Physiol.* 16, 401-412 (1904). (TRANSLATION by Ulf Marquardt). Über einen in biologischer Beziehung wichtigen Einfluss, den die Kohlensäurespannung des Blutes auf dessen Sauerstoffbindung übt
- ii. Reading: Malte, H. and Lykkeboe, G. The Bohr/Haldane effect: a model-based uncovering of the full extent of its impact on O₂ delivery to and CO₂ removal from tissues. *J. Appl. Physiol.* 125:916-922, 2018.

d. Project 3: Modeling the oxygen-hemoglobin dissociation curve

3. Module 3: The alveolar gas equation

a. Lecture 10: Alveolar gas equation: origins and application

- i. Reading: Fenn W.O., H. Rahn, and A.B. Otis. A theoretical study of the composition of the alveolar air at altitude. *Am. J. Physiol.* 146:637-653, 1946.
- ii. Reading: Cruickshank S., and N. Hirschauer. The alveolar gas equation. *Continuing Education in Anesthesia, Critical Care and Pain.* 4:24-27, 2004.

b. Lecture 11: Alveolar CO₂ and alveolar ventilation

- i. Reading: Wang M.C., Corbridge T.C., McCrimmon D.R., and Walter J.M. Teaching an intuitive derivation of the clinical alveolar equations: mass balance as a fundamental physiological principle. *Adv. Physiol. Education* 33:145-152, 2020.

c. Project 4: Prediction of alveolar gas partial pressures with hypo- and hyper-ventilation

4. Module 4: Diffusion

a. Lecture 12: Diffusion of gases between plasma, interstitial fluid, and intracellular compartments

- i. Reading: A. Krogh. The rate of diffusion of gases through animal tissues, with some remarks on the coefficient of invasion. *J. Physiol.* 52:391-408, 1919.
- ii. Reading: A. Krogh. The number and distribution of capillaries in muscles with calculations of the oxygen pressure head necessary for supplying the tissue. *J. Physiol.* 52:409-415, 1919.
- iii. Reading: D. Goldman. Theoretical models of microvascular oxygen transport to tissue. *Microcirculation* 15:795-811, 2008.

b. Lecture 13: Diffusion capacity of alveoli

- i. Reading: Bates D.V., N.G. Boucot, and A.E. Dormer. The pulmonary diffusing capacity in normal subjects. *J. Physiol.* 129:237-252, 1955.
- ii. Reading: Lewis B.M., T.-H. Lin, F.E. Noe, and E.J. Hayford-Welsing. *J. Clin. Invest.* 38:2073- 2086, 1959.

c. Project 5: Diffusion of gases

5. Module 5: Acidosis and Alkalosis

- a. Lecture 14: Acid-base balance and principles of mass action (Henderson-Hasselbach equation).
 - i. Reading: L.J. Henderson. Concerning the relationship between the strength of acids and their capacity to preserve neutrality. *Am. J. Physiol.* 21:173-179, 1908.
 - ii. Reading: H.N. Po and N.M. Senozan. The Henderson-Hasselbach equation: Its history and limitations. *J. Chem. Education.* 78:1499-1503, 2001.
 - iii. Reading: V. Fencel and D.E. Leith. Stewart's quantitative acid-base chemistry: Applications in biology and medicine. *Resp. Physiol.* 91:1-16, 1993.
- b. Project 6: Modeling blood pH

6. Term Paper: Transport of oxygen from atmosphere to mitochondrion.

- a. Descriptive essay (minireview) of the theoretical and quantitative mechanisms of transport of oxygen to the mitochondrion.
 - i. Must be at least 2000 words
 - ii. Must have at least 20 references from the peer reviewed literature

Due Dates: This course is designed for asynchronous learners and therefore allows time management flexibility for the learners. Students are expected, however, to complete assignments in each module according to the following schedule. Deviation from this schedule may be granted by the course director after request by the learner.

Project 1: May 24

Project 2: June 7

Project 3: June 21

Project 4: June 28

Project 5: July 5

Project 6: July 19

Term Paper: July 26

University Policies and Resources

Information about grading policies, support for students with disabilities, course evaluations, the Honor Code, and other course policies and campus resources can be found on the [Syllabus Policies page](#).

Attendance Policy

Excused and Unexcused Absences

Students may only participate in classes if they are registered officially or approved to audit with evidence of having paid audit fees. The Office of the University Registrar provides official class rolls to instructors.

Students are responsible for satisfying all academic objectives as defined by the instructor. Absences count from the first-class meeting.

Acceptable reasons for absence from or failure to engage in class include illness; Title IX-related situations; serious accidents or emergencies affecting the student, their roommates, or their family; special curricular requirements (e.g., judging trips, field trips, professional conferences); military obligation; severe weather conditions that prevent class participation; religious holidays; participation in official university activities (e.g., music performances, athletic competition, debate); and court-imposed legal obligations (e.g., jury duty or subpoena). Other reasons (e.g., a job interview or club activity) may be deemed acceptable if approved by the instructor.

For all planned absences, a student in a situation that allows an excused absence from a class, or any required class activity must inform the instructor as early as possible prior to the class. For all unplanned absences because of accidents or emergency situations, students should contact their instructor as soon as conditions permit.

Students shall be permitted a reasonable amount of time to make up the material or activities covered during absence from class or inability to engage in class activities because of the reasons outlined above.

If a student does not participate in at least one of the first two class meetings of a course or laboratory in which they are registered, and they have not contacted the department to indicate their intent, the student can be dropped from the course. Students must not assume that they will be dropped, however. The department will notify students if they have been dropped from a course or laboratory.

The university recognizes the right of the instructor to make attendance mandatory and require documentation for absences (except for religious holidays), missed work, or inability to fully engage in class. After due warning, an instructor can prohibit further attendance and subsequently assign a failing grade for excessive absences.

Religious Holidays Guidelines

At the University of Florida, students and faculty work together to allow students the opportunity to observe the holy days of their faith. A student should inform the faculty member of the religious observances of their faith that will conflict with class attendance, with tests or examinations, or with other class activities prior to the class or occurrence of that test or activity. The faculty member is then obligated to accommodate that particular student's religious observances. Because students represent a myriad of cultures and many faiths, the University of Florida is not able to assure that scheduled academic activities do not conflict with the holy days of all religious groups. Accordingly, individual students should make their need for an excused absence known in advance of the scheduled activities.

The Florida Board of Education and state law govern university policy regarding observance of religious holidays.

Guidelines

- Students, upon prior notification to their instructors, shall be excused from class or other scheduled academic activity to observe a religious holy day of their faith.
- Students shall be permitted a reasonable amount of time to make up the material or activities covered in their absence.
- Students shall not be penalized due to absence from class or other scheduled academic activity because of religious observances.

If a faculty member is informed of or is aware that a significant number of students are likely to be absent from class because of a religious observance, the faculty member should not schedule a major exam or other academic event at that time.

A student who is to be excused from class for a religious observance is not required to provide a second party certification of the reason for the absence. Furthermore, a student who believes that they have been unreasonably

denied an education benefit due to religious beliefs or practices may seek redress through the student grievance procedure.

Absence due to Illness

A student who is absent from class or any required class-related activity because of illness should contact their instructor, if feasible, as early as possible prior to the missed class or activity.

Students shall be permitted a reasonable amount of time to make up the material or activities covered during an excused absence.

Students should contact their college by the deadline to drop a course for medical reasons. Students can petition the Dean of Students Office to drop a course for medical reasons. The university's policy regarding medical excuse from classes is maintained by the Student Health Care Center.

Twelve-Day Rule

Students who participate in university-sponsored athletic or scholarly activities are permitted to be absent 12 scholastic days per semester without penalty. A scholastic day is any day on which regular class work is scheduled as defined in the approved university calendar.[More Info](#)

The student or student's advisor must notify the instructor as early as possible prior to the anticipated absence to allow ample time for accommodations. Instructors must be flexible and not penalize students when re-scheduling during-term and final exams, class assignments, and other required activities and must follow the UF Attendance Policy herein and UF Examination Policies. As noted in the UF Examination Policies, during-term exams should be re-scheduled no later than before the end of the semester, while final exams no later than 90 days after the originally scheduled exam time. However, instructors are encouraged to re-schedule final and during-term exams, assignments, and other activities as soon as possible after the last day of the absence and must not penalize the student in any way.[More Info](#)

A group's schedule that requires absence of more than 12 scholastic days should be adjusted so that no student is absent from campus more than 12 scholastic days. Students who previously have been warned in writing by their instructor about the impact of absences on their individual class performance should not incur additional absences, even if they have not been absent 12 scholastic days. The student is responsible to maintain satisfactory academic performance and attendance.

Course Policies and Resources

Borrowing from the UF Library

Distance learners may borrow materials from the UF Libraries. They may also borrow from associated non-UF libraries using Interlibrary Loan (ILL). See the main library site for distance learners at

<http://guides.uflib.ufl.edu/distancelearners>Links to an external site.. See more on ILL -- including an FAQ specially for distance learners -- at <http://cms.uflib.ufl.edu/accesssupport/InterlibraryLoanLinks> to an external site.

Accommodations for Students with Disabilities

Students requesting accommodations must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student, who must then provide this documentation to the course director when requesting an accommodation. Contact the Disability Resources Center, <https://dso.ufl.edu/> for information about

available resources for students with disabilities.

Academic Honesty

Online classes are subject to the same requirements of academic honesty as all on-campus classes. Please review and be familiar with the Student Conduct Code and Student Honor Code, which can be found at <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code>. UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Student Honor Code specifies a number of behaviors that violate the code, and the possible sanctions. Furthermore, you are obliged to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult the instructor or course coordinator.

Plagiarism

Plagiarism is presenting another person's work as your own. Cheating and plagiarizing are against the University of Florida Student Conduct Code. Submissions in this course are checked via Turnitin (<http://www.turnitin.com>), a service that compares documents with each other as well as with pages on the Internet and with other assignments previously submitted by other students. If portions of your document were directly copied and pasted from another student's assignment (past or present) or from the Internet, that constitutes plagiarism. Any form of plagiarism will be investigated as set out by the University of Florida Student Conduct Code. From your citations and references, the reader of your paper should be able to tell the source of all your outside information. It may be acceptable to place a few comments in quotes with a citation, but it is never acceptable to copy and paste a long string of text from a source, even if it is cited and even if you change a few words. Anything from another source that is not in quotations must be paraphrased. Also, please note that UF policies require that you create original work for each course. Thus, students are not permitted to submit papers they prepared previously outside of this class, such as for high school or other UF courses.

AI Use Acknowledgment

For this graduate level course, GMS6400C Distance Principles of Physiology, it is imperative that all work submitted is your own. The use of AI tools, including but not limited to, generative language models, code generation tools, and automated essay writer, is strictly prohibited for all assignments. Any work found to have been produced with the aid of such AI tools will result in a zero for that assignment. This policy is in place to ensure the integrity of your learning experience and to respect the academic standards of this course. If you have any questions about this policy or need assistance with your work, please do not hesitate to reach out to your instructor.

GatorEvals UF Faculty Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the

highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments.

For more information, please see:

<http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Health and Wellness U Matter, We Care:

If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit umatter.ufl.edu/ to refer or report a concern and a team member will reach out to the student in distress.

Counseling and Wellness Center:

Visit counseling.ufl.edu/ or call 352-392-1575 for information on crisis services as well as non-crisis services.

Student Health Care Center:

Call 352-392-1161 for 24/7 information to help you find the care you need, or visit shcc.ufl.edu/.

University Police Department:

Visit police.ufl.edu/ or call 352-392-1111 (or 9-1-1 for emergencies).

UF Health Shands Emergency Room / Trauma Center:

For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; ufhealth.org/emergency-room-trauma-center.

Academic Resources:

E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu.

Career Connections Center:

Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services career.ufl.edu/.

Library Support:

cms.uflib.ufl.edu/ask various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center:

Broward Hall, 352-392-2010 or to make an appointment 352-392-6420. General study skills and tutoring.

teachingcenter.ufl.edu/

Writing Studio:

2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers. writing.ufl.edu/writing-studio/

Student Complaints On-Campus:

sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/

On-Line Students Complaints:

distance.ufl.edu/student-complaint-process/

Professionalism Expectations

Maintain honesty, respect, responsibility, and integrity in all course interactions.

Syllabus changes

You will be notified if there are major changes to the syllabus.

Late and Make Up Work Policy

Late Work Policy

For all assignments that require manual grading (e.g., research papers, projects, exams), unless you have an approved excused absence, a 10% deduction will be applied for each week the assignment is late.

Technology in the Classroom

Technical Support

If you have technical difficulties with downloading and accessing course files, email the academic administrator, Taylor Greene by Canvas email with a detailed description of the problem. If your technical issues are trouble with accessing the VPN or your UF account, please contact the UF Help Desk at 352-392-4357.