

# Physics and Chemistry of the Atmosphere

## Physics 335, Fall 2025

Physics 107, Wed/Fri 1:00 – 2:15 PM

Updated: August 2025

### INSTRUCTORS

Dr. Brent McBride

UMBC Physics 328, voice: (443)-878-6536

Office Hours: After class, or by appointment.

Dr. Qianqian Song

UMBC Technology Research Center (TRC) 178, voice: (443)-630-7292

Office Hours: After class, or by appointment.

### COURSE DESCRIPTION

PHYS335 is a first course in the physical and chemical principles that led to the formation of the atmosphere of our planet, its structure, and weather and climate processes. It surveys a range of core topics in atmospheric sciences, including atmospheric thermodynamics, atmospheric dynamics, general circulation, radiation, clouds, air pollution, and chemistry (topics we will cover are listed in the Course Schedule below). The physical principles together with mathematical techniques presented this semester should help you with many of the upper-level Physics classes (and graduate courses, if you choose to go on) you will be taking in the future, as well as give context to some of the environmental issues facing society today, including weather circulations, global warming, and air pollution.

**Prerequisites:** Physics 121/H (or instructor's permission/equivalent coursework). This class is built around prior knowledge of algebra, trigonometry, and geometry (including introductory level understanding of integrals, derivatives, differential equations).

As the semester progresses, we may make some (e.g., Python) computer codes and data files available for you to download over the web, and use them to explore and reinforce certain physics concepts.

### OFFICE HOURS

Office hours will be set after classes start. Typically, we will be available after lectures to answer questions, and you can always contact us using email or come to our offices.

## LEARNING GOALS

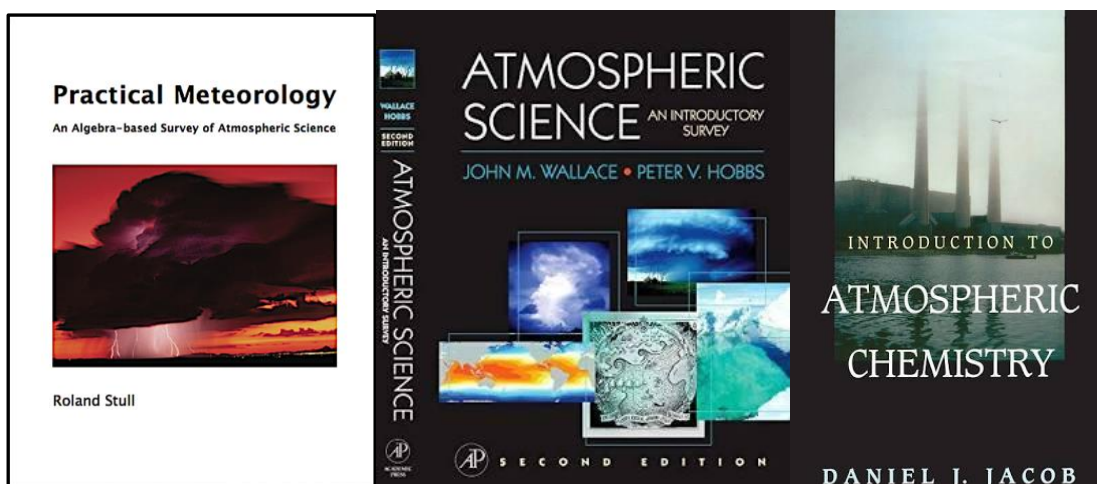
By the end of the course (by fulfilling the course expectations), you will develop a rich understanding of major processes of weather and climate, and will be able to describe and analyze physical/chemical principles behind those processes. Specifically, you will:

- identify key atmospheric processes of global, synoptic, and smaller scales, and connect them to weather and climate.
- explain the global energy budget and the general circulation of Earth's atmosphere.
- answer basic questions regarding radiative transfer of light in the atmosphere, synoptic meteorology, vertical transport of pollutants, cloud formation, etc.
- explain the physical/chemical principles range of atmospheric phenomena such as global warming, ozone holes, acid rain, rainbows, etc.
- develop skills in critical thinking, technical reading, and scientific communication through writing formal academic reports and oral presentations.

## COURSE MATERIALS

Since there will be a wide variety of topics presented in the class during the semester, we have chosen one general textbook (by Wallace and Hobbs), as well as two books available online. In addition, we will be presenting material from other books or articles.

- **Textbook:** *Atmospheric Science: An Introductory Survey*, 2<sup>nd</sup> Ed. by Wallace & Hobbs
- **Online Textbook 1:** *Practical Meteorology: An Algebra-based Survey of Atmospheric Science* by R. Stull ([https://www.eoas.ubc.ca/books/Practical\\_Meteorology/](https://www.eoas.ubc.ca/books/Practical_Meteorology/))
- **Online Textbook 2:** *Introduction to Atmospheric Chemistry*, by Daniel J. Jacob, 1999 (<https://acmg.seas.harvard.edu/education-introduction-atmospheric-chemistry/>)



## GRADING

The final grade will be determined from

Class participation	10%
Homework	30%
Midterm exam	20%
Final exam	20%
Class project	20%

Grade breakdown: (A) 90-100, (B) 80-89, (C) 70-79, (D) 60-69, (F) below 60.

## Participation

You are expected to attend class regularly. Your presence in class is part of participation. Participation also means to do the readings carefully and contribute significantly to our discussions. You should come to class having read the assigned material for that day and with something to say about it.

## Homework and the Use of Artificial Intelligence

Many Physics education studies show that students do much better when they keep up with the material and come to lectures prepared - this course is organized with this in mind. Homework will be collected **before midnight of the due date** and graded. The hour exams during the semester will be based on the lecture material and homework.

Homework solutions will be posted after the due date. You are welcome to work in groups, but the final turned-in homework should represent *your* work. **In this class, you are expected to do your calculations and explain your reasoning on the homework without aid from**

**artificial intelligence, such as ChatGPT and other large language models (LLMs).** This class is looking to build the kind of independent, creative, and critical thinking that is necessary to tackle real world problems in atmospheric science. This can only be done with a focused effort on your part and persistent, independent study.

**However, you may use LLMs as a supplemental study tool. Exercise caution and always double-check/verify the output.** It is important to constantly challenge what the LLM produces against the textbook, your instructors and peers, and class notes. Do not ever take the output of an LLM at face value. Use of LLMs are not permitted in class, as part of the class projects, or on exams.

Finally, late homework will not be accepted without a prior arrangement.

## **Exams/Project**

There will be two midterm exams, and one class project. Two midterm exams will consist of problems of the type practiced through doing the homework. You will be expected to be able to come up with both numeric and explanatory answers as needed. The date and format of midterms will be announced at least a week in advance; it is your responsibility to stay informed about the dates.

We will reserve a couple of classes (at the end of the semester) for group project presentations. Based on class size we expect about 3-4 groups each consisting of about 2-3 people. Each person in the group should make a substantial contribution to the presentation. The projects should be based on what is/was taught in class. Please select a topic and check its suitability with the instructors well in advance, and prepare enough slides for a 20-minute presentation per group.

For both homework and exams, you need to show your work clearly (which also includes being neat and legible!), with all steps and assumptions, to get credit. *The easiest way to do this is to get into the habit of neatly showing all your steps and reasoning, on your homework.* Even if the final answer is wrong, partial credit will be given where it is due. Draw diagrams if needed, and use the correct units. No work shown implies no credit, unreadable solutions also will not be given credit. **Missed exams** can only be made up under very special circumstances, such as official university business or illness. Please make prior arrangements with us well in advance.

## **COURSE SCHEDULE**

Below is the generic calendar outline for the semester. Actual hour exam dates will be announced about a week in advance; *YOU are responsible for knowing the dates of exams (and presentation schedule), so plan to attend all classes!!*

Wed, Aug 27	First day of Fall 2025 class
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Friday, Oct 17	Midterm exam
We/Fr, Dec 3 & 5	Class project presentations
Tue, Dec 9	Last day of Fall 2025 classes
Wed, Dec 10	Study day (no classes)
Fri, Dec 12	Final exam (1:00-3:00PM)

## Topic breakdown

This is a rough outline *and is subject to change*.

Week	Date	Lead Instructor	Topic	Material (Readings)
1	Aug 27/29	McBride/Song	Class Outline Introduction and Overview	Syllabus W&H Chapter 1
2	Sep 3/5	Song	The Earth System	W&H Chapter 2
3	Sep 10/12	Song	The Earth System	W&H Chapter 2,4
4	Sep 17/19	Song	Radiative Transfer	W&H Chapter 4
5	Sept 24/26	Song	Radiative Transfer	W&H Chapter 4
6	Oct 1/3	Song	Atmospheric Aerosols	Jacob Chapter 7
7	Oct 8/10	McBride	Thermodynamics	W&H Chapter 3 Stull Chapter 3
8	Oct 15/17		<b>Study Day/Open Room(Oct 15)</b> <b>Midterm Exam (Oct 17)</b>	W&H Chapter 3 Stull Chapter 3
9	Oct 22/24	McBride	Thermodynamics	W&H Chapter 3 Stull Chapter 3

10	Oct 29/31	McBride	Thermodynamics	W&H Chapter 5 Jacob Chapter 9-10
11	Nov 5/7	McBride	Clouds and Precipitation	W&H Chapter 6
12	Nov 12/14	McBride	Clouds and Precipitation	W&H Chapter 6
13	Nov 19/21	McBride	General Circulations Atmospheric Chemistry	W&H Chapter 7
14	Nov 26/28	McBride	Remote Sensing of the Atmosphere	Special topic
15	Dec 3/5	McBride	<b>Class Project Presentations</b> about 20-25 min/group	
16	Dec 10/12		<b>Study Day (Dec 10)</b> <b>Final Exam (Dec 12)</b>	

## COURSE POLICIES & RESOURCES

### Attendance policy

You are expected to attend class regularly. Your presence in class is a kind of participation. Therefore, more than 2 unexcused absences will lower your grade. More than 4 such absences may result in failure of participation grade. It is your responsibility to inform instructors of any extenuating circumstances affecting attendance or class performance.

### Cellphone policy

Cellphones may be brought to class, but please remember to silence them. If you are expecting an urgent call about a private matter, you are exempt from this policy; but please let us know about this ahead of time.

### Late Policy

Late assignments are only accepted under extenuating circumstances.

### Course caveat

The itinerary for the course is subject to change. In case of any emergency or unforeseen obstacles the instructor will email students with information regarding the changes or accommodations made. In the event of a major emergency, course requirements, deadlines and

grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Every student is responsible for checking their mail and being informed about any changes to the course schedule.

## **Diversity Statement**

Our role as an instructor is not to convince you to share my beliefs. My mission is to help you develop your critical thinking and analysis skills so that you can form strong arguments and support them.

## **UMBC's Vision Statement**

Our UMBC community redefines excellence in higher education through an inclusive culture that connects innovative teaching and learning, research across disciplines, and civic engagement.

## **Technology: Access, Requirements, Resources, Support**

To help ensure that UMBC students are equipped for academic success, the Division of Information Technology (DoIT) provides a wealth of resources and support, including tips for getting online and minimum specifications to consider when purchasing a computer. To learn more about the resources and support that DoIT offers to students, visit [doit.umbc.edu/students](http://doit.umbc.edu/students). If you are experiencing technological difficulties or if you lack reliable access to computer hardware or an internet connection, please notify the course instructor as soon as possible.

## **Academic integrity**

UMBC's policy on academic honesty is in effect. By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. These principles and policies apply in both face-to-face and online classes. Resources for students about academic integrity at UMBC are available at <https://academicconduct.umbc.edu/resources-for-students/>.

If you have any questions concerning plagiarism, refer to the Purdue Online Writing Lab (OWL) at <http://owl.english.purdue.edu/owl/printable/589>

## **Resources to Help you Succeed in Courses**

Many students need additional support to succeed in courses. Helpful resources:

- UMBC's Academic Success Center (ASC) provides a range of resources to support students as they progress toward degree completion. They will continue to offer all of their services online.
- The ASC has created a specialized set of Online Learning Resources.

In addition, check out the following resources:

- Tutoring and Instructional Support: Online tutoring and writing support, supplemental instruction, study sessions, academic success meetings, placement testing, academic advocacy, first year alerts, and academic success meetings.
- Academic Advocates: Advocates work one-on-one with students who need support navigating academic and institutional challenges that may adversely affect their persistence, progression and timely completion of degree. No matter how complex the concerns (i.e., personal, academic, or financial), Academic Advocates will work together with students to review their progress, present options toward graduation, map out a plan for success, and facilitate communication and connections with the appropriate campus resources.

## **Enrollment Dates and Deadlines**

Students must be familiar with the academic policies and enrollment dates and deadlines as published in the Undergraduate Catalog and the Academic Calendar. They are also responsible for managing their course enrollment(s) accordingly.

## **Accessibility and Disability Accommodations, Guidance and Resources (required)**

Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that creates equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at [sds.umbc.edu](https://sds.umbc.edu) for registration information and office procedures.

SDS email: [disAbility@umbc.edu](mailto:disAbility@umbc.edu)

SDS phone: [410-455-2459](tel:410-455-2459)



If you will be using SDS approved accommodations in this class, please contact the instructor to discuss implementation of the accommodations. During remote instruction requirements due to COVID, communication and flexibility will be essential for success.

### **Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination (required)**

[UMBC Policy](#) in addition to federal and state law (to include Title IX) prohibits discrimination and harassment on the basis of sex, sexual orientation, and gender identity in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment, or related retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources. The Title IX Coordinator can be reached at [titleixcoordinator@umbc.edu](mailto:titleixcoordinator@umbc.edu) or 410-455-1717.

You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.

If you are interested in making a report, please use the [Online Reporting/Referral Form](#). Please note that, if you report anonymously, the University's ability to respond will be limited.

### **Notice that Faculty and Teaching Assistants are Responsible Employees with Mandatory Reporting Obligations**

All faculty members and teaching assistants are considered Responsible Employees, per UMBC's [Policy on Sexual Misconduct, Sexual Harassment, and Gender Discrimination](#). Faculty and teaching assistants therefore required to report all known information regarding alleged conduct that may be a violation of the Policy to the Title IX Coordinator, even if a student discloses an experience that occurred before attending UMBC and/or an incident that only involves people not affiliated with UMBC. Reports are required regardless of the amount of detail provided and even in instances where support has already been offered or received.

While faculty members want to encourage you to share information related to your life experiences through discussion and written work, students should understand that faculty are required to report past and present sexual harassment, sexual assault, domestic and dating violence, stalking, and gender discrimination that is shared with them to the Title IX Coordinator so that the University can inform students of their [rights, resources, and support](#). While you are encouraged to do so, you are not obligated to respond to outreach conducted as a result of a report to the Title IX Coordinator.

If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, UMBC has a number of [Confidential Resources](#) available to support you:

[Retriever Integrated Health](#) (Main Campus): 410-455-2472; Monday – Friday 8:30 a.m. – 5 p.m.; For After-Hours Support, Call 988.

[Center for Counseling and Well-Being](#) (Shady Grove Campus): 301-738-6273; Monday-Thursday 10:00a.m. – 7:00 p.m. and Friday 10:00 a.m. – 2:00 p.m. (virtual) [Online Appointment Request Form](#)

Pastoral Counseling via [The Gathering Space for Spiritual Well-Being](#): 410-455-6795; [i3b@umbc.edu](mailto:i3b@umbc.edu); Monday – Friday 8:00 a.m. – 10:00 p.m.

### **Other Resources**

[Women’s Center](#) (open to students of all genders): [410-455-2714](tel:410-455-2714); [womenscenter@umbc.edu](mailto:womenscenter@umbc.edu); Monday – Thursday 9:30 a.m. – 5:00 p.m. and Friday 10:00 a.m. – 4 p.m.

[Shady Grove Student Resources](#), [Maryland Resources](#), [National Resources](#).

### **Child Abuse and Neglect**

Please note that Maryland law and [UMBC policy](#) require that faculty report all disclosures or suspicions of child abuse or neglect to the Department of Social Services and/or the police even if the person who experienced the abuse or neglect is now over 18.

### **Pregnant and Parenting Students**

UMBC’s [Policy on Sexual Misconduct, Sexual Harassment and Gender Discrimination](#) expressly prohibits all forms of discrimination and harassment on the basis of sex, including pregnancy. Resources for pregnant, parenting and breastfeeding students are available through the University’s [Office of Equity and Civil Rights](#). Pregnant and parenting students are encouraged to contact the Title IX Coordinator to discuss plans and ensure ongoing access to their academic program with respect to a leave of absence – returning following leave, or any other accommodation that may be needed related to pregnancy, childbirth, adoption, breastfeeding, and/or the early months of parenting.

In addition, students who are pregnant and have an impairment related to their pregnancy that qualifies as disability under the ADA may be entitled to accommodations through the [Office of Student Disability Services](#).

### **Religious Observances & Accommodations**

UMBC [Policy](#) provides that students should not be penalized because of observances of their religious beliefs, and that students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences or requested modifications for religious observances in advance, and as early as possible. For questions or guidance regarding religious observances and accommodations, please contact the Office of Equity and Civil Rights at [ecr@umbc.edu](mailto:ecr@umbc.edu).

### **Hate, Bias, Discrimination and Harassment**

UMBC values safety, cultural and ethnic diversity, social responsibility, lifelong learning, equity, and civic engagement.

Consistent with these principles, [UMBC Policy](#) prohibits discrimination and harassment in its educational programs and activities or with respect to employment terms and conditions based on race, creed, color, religion, sex, gender, pregnancy, ancestry, age, gender identity or expression, national origin, veterans status, marital status, sexual orientation, physical or mental disability, or genetic information.

Students (and faculty and staff) who experience discrimination, harassment, hate, or bias based upon a protected status or who have such matters reported to them should use the [online reporting/referral form](#) to report discrimination, hate, or bias incidents. You may report incidents that happen to you anonymously. Please note that, if you report anonymously, the University's ability to respond may be limited.