

## **CHEM/ENVS 328 Introduction to Atmospheric Chemistry: From Theory to Action**

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### **Course Outline**

The course will provide basic knowledge in atmospheric chemistry, focusing on the physical and chemical processes in the atmosphere. Using the knowledge learned through this course, students will be able to: 1) explain some of the most important atmospheric phenomena from the local to the global scale; 2) critically assess public discussions and media coverage on air pollution and climate change; and 3) understand how the problem is related to their everyday lives and disseminate the knowledge to the community and find possible solutions. In addition to learning the basics of air pollution and climate change through active-learning methodologies in classrooms on campus, students will participate in the Atlanta Science Festival to showcase the basic science behind air pollution and climate change to the public. The students will also be involved in teaching air pollution to middle school students at the King Middle School. Each student is required to conduct a final research project on a topic related to climate change and they will present their findings at the second Day of Scholarship that my colleague (Justin Burton in Physics) and I are organizing as a part of the Climate@Emory initiative in April.

### **Proposed Innovation**

I propose to turn the traditional teaching-based class to an active-learning, community-engaged, and research-driven class. First, students will learn the basic science behind air pollution in classroom throughout the semester. I will include newspaper discussion in each class to have them engaged in the current issues and some of the classes will be flipped, focusing on problem solving in classrooms than doing lectures. As one of the class activities, students will make their own personal air quality sensor after they learn the basics of particulate matter in the atmosphere.

The innovative part of the class is three-fold. First, students will participate in the Atlanta Science Festival in March to disseminate the knowledge of air pollution and climate change. They will showcase their personal air quality sensors that they will create in class as one of the activities, along with other instruments to measure air pollution. I have participated in the Atlanta Science Festival for the last three years and I would like to involve more students for the next year's festival. Studies show that students learn more when they themselves are involved in teaching and this is also a nice way to make the class that can be very dry to a more active, hands-on class. I will encourage students to come up with a game and other demonstrations that will be good for teaching the material to all levels of audience, as well as the demonstration of the air quality sensors.

The second innovation is the hands-on teaching that students will do at the King Middle School. Students will go to the King Middle School to teach them the science behind air pollution and how to create air quality sensors from scratch. The students in class, together with middle school students, will then test the impact of different pollution sources and come up with solutions for Atlanta to obtain better air quality. The sensors that they will build are based on the EPA's hands-on activities for the K-12 students (<https://www.epa.gov/air-research/hands-activities-and-other-resources-air-quality-and-climate-change-teachers>). I have already discussed

this possibility with Jennifer Cappelli, the Principal Fellow at Atlanta Public Schools, who work at the King Middle School and she has agreed to work with me on this. This will also make the Emory students more aware of the equity and diversity issues we have in Atlanta, as the Martin Luther King Jr. Middle School is a Title 1 school.

The third innovation is the final project that they will do for class on climate change. I am on the Energy Task Force and I have discussed the potential of teaming up students with several facilities staff to find a way for the students to be more involved in the energy issues on campus. Each student will be assigned to a group of three to conduct a hands-on research project on climate change and they will present their results at the second Day of Scholarship that my colleague (Justin Burton in Physics) and I are organizing as a part of the Climate@Emory initiative in April. They will also actively participate in the discussion during the conference, where they will be a part of the research community. For the Day of Scholarship, we are currently proposing to bring faculty and students from the many universities in Georgia to Emory campus to share their climate change research, similar to the Day of Scholarship in 2014. This time we hope to expand our representation to include undergraduate-only institutions, HBCUs, and some local industry representatives. We plan to have a keynote speaker and an invited speaker for each of the sessions (Earth system modeling, climate vulnerability and adaptation, and climate change in Georgia), as well as the local faculty and students. Students will present their research at a poster session, along with the other students working on climate change issues.

In sum, students will be exposed to hands-on activities that will enhance learning and they will have opportunities to work with the community in disseminating what they learn. In addition, they will conduct research on Emory campus related to energy use and will present to other students and faculty in the field. I hope that this class will provide opportunities for students to be more engaged in the community and bring in positive change to Emory, in addition to learning fundamental science.

### **Budget**

The major cost is for a student to create air quality sensor with middle school students.

Creating one particle sensor costs:

- Arduino Uno R3, \$27
- Half-size breadboard, \$4.5
- Breadboarding wire bundle, \$6
- Diffused Red 5mm LED, \$4
- 9V battery clip with 5.5mm/2.1mm plug, \$2.7
- 1K Ohm resistor, \$0.04
- particle sensor – Shinyei PPD42NJ, \$15
- 9V battery, \$3

Subtotal: \$62.24 per particle sensor

- 25 sensors for each student in class (\$1556)
- 20 sensors for each middle school student we will teach at King Middle School (\$1244.8)
- 2 extra for the Atlanta Science Festival display (\$124.48)

Subtotal: \$2925.28 for 47 particle sensors to be built

- Miscellaneous cost to the trip to the Atlanta Science Festival and to King Middle School

Subtotal: \$74.42

**Total requested: \$3000**

### **Schedule for integration of the proposed project in the classroom setting**

January: Learn the material in class and through in-class activities

February: Go to King Middle School to teach students about air pollution and build sensors together

March: Present at the Atlanta Science Festival

April: Present their group research at the Day of Scholarship

### **Assessing impact on Emory students**

I will be using student feedback form three times during the class. First is the survey to assess the interest in the activities that I plan to do at the beginning of the class. Second is the feedback survey after the King Middle School teaching to assess the impact of creating the sensor themselves and demonstrating it to the community. The third will be after the Atlanta Science Festival. We will also conduct a participant survey at the Day of Scholarship to understand the impact on students. I will also conduct a class evaluation at the end where I ask them to fill out detailed written comments in addition to the university class evaluation.

## ***CHEM 328/ENVS 328 Introduction to Atmospheric Chemistry***

Spring 2017

Instructor: Prof. Eri Saikawa ([eri.saikawa@emory.edu](mailto:eri.saikawa@emory.edu))

Office: Math and Science Center E512, Tel: 404-727-0487

Office Hours: T 1-3pm

The course will provide basic knowledge in atmospheric chemistry, focusing on the physical and chemical processes in the atmosphere. Using the knowledge learned through this course, students will be able to: 1) explain some of the most important atmospheric phenomena from the local to the global scale; 2) critically assess public discussions and media coverage on air pollution; and 3) understand how the problem is related to their everyday lives and disseminate the knowledge to the community and find possible solutions.

### Primary Textbook:

Jacob, Daniel (DJ): Introduction to Atmospheric Chemistry, Princeton University Press, 1999. Available online: <http://acmg.seas.harvard.edu/people/faculty/djj/book/index.html>

### Supplementary Textbook:

Seinfeld, John H., and Pandis, Spyros N.: Atmospheric Chemistry and Physics – From Air Pollution to Climate Change, John Wiley and Sons, 2006. Available on Knovel:

[http://www.knovel.com/web/portal/browse/display?EXT\\_KNOVEL\\_DISPLAY\\_bookid=2126](http://www.knovel.com/web/portal/browse/display?EXT_KNOVEL_DISPLAY_bookid=2126)

Wark, Kenneth, Cecil F. Warner, and Wayne T. Davis (KW): Air Pollution: Its Origin and Control, Addison-Wesley, 1997.

### Goals:

- Understand the science behind major atmospheric chemistry issues.
- Understand the causes of important regional/global environmental problems.
- Able to critically analyze public discussions on the science of air pollution.
- Able to clearly explain and engage the community on air pollution and climate change issues.

### Assignments:

Readings; In-class assignments and quizzes; homework assignments; class discussions; Atlanta Science Festival presentation; King Middle School teaching; and final research project

### Course Structure:

Homework is given and is due by the beginning of the class on the date indicated in the syllabus. In-class quizzes are given at the beginning of the class on the date indicated in the syllabus. **No late assignments will be accepted without prior approval by the instructor.** Homework assignments can be discussed in groups, but **MUST** be written up independently. Evidence of copying will result in a zero grade for the assignment. Midterm project 1 will be presented at the King Middle School and Midterm Project 2 will be presented at the Atlanta Science Festival. The final research project will be presented at the Day of Scholarship.

### Grading:

Participation and Class Discussion (including Seminar Attendance) – 10%

4 Homework Assignments – 20%

4 in-class Quizzes – 20%

Final research paper proposal – 5%

King Middle School teaching – 10%

Atlanta Science Festival presentation – 10%

Day of Scholarship presentation – 10%

Final research paper – 15%

Extra Credit – up to 10% (attending one of the listed seminars at the end of the syllabus will count as 2 extra points)

### Preliminary Class Schedule:

Date		Topic	Reading	Assignment
January	10	T	Introduction	
	12	Th	Atmospheric Composition	DJ Ch. 1
	17	T	Atmospheric Pressure	DJ Ch. 2
	19	Th	Simple Models	DJ Ch. 3
	24	T	Atmospheric Transport	DJ Ch. 4
	26	Th	The Greenhouse Effect 1	DJ Ch. 7
	31	T	The Greenhouse Effect 2 Energy issues at Emory – meeting with Facilities	DJ Ch. 7
February	2	Th	Aerosols 1	DJ Ch. 8
	7	T	Personal air quality monitor	DJ Ch. 8
	9	Th	Personal air quality monitor	
	14	T	King Middle School prep	
	16	Th	Teaching at King Middle School	
	21	T	Aerosols 2	
	23	Th	Geochemical Cycles	DJ Ch. 8
	28	T		DJ Ch. 6
March	2	Th	Chemical Kinetics	DJ Ch. 9
	7	T	Spring Break	
	9	Th	Spring Break	
	14	T	Chemical Kinetics	DJ Ch. 9
	16	Th	Stratospheric Ozone 1	DJ Ch. 10
	21	T	Atlanta Science Festival Prep	DJ Ch. 10
	23	Th	Atlanta Science Festival Prep	
	28	T	Stratospheric Ozone 2 Oxidizing Power of the	DJ Ch. 10
	30	Th	Troposphere 1 Oxidizing Power of the	DJ Ch. 11
April	4	T	Troposphere 2	DJ Ch. 11
	6	Th	Ozone Air Pollution	DJ Ch. 11
	11	T	Review	

13 Th In-class quiz 4  
18 T Research presentations  
20 Th Research presentations

Extra Credit Event List

TBD