

Availability to Match Partners

Please fill out scheduling form if possible.

Return ASAP by email if not.

- While most of the assignments will be independent, you will be matched with at least one partner and asked to interact with them at various points in class.
- While little outside of classroom work is required, we do want you to have the option to work with each other if desired, so the primary partner matching will be based upon your shared availabilities. You are allowed/encouraged to work with other classmates though.

Monday, August 24	Your Name	Preferred Email to Send Zoom Link
Noon		
1:00 PM		
2:00 PM		
3:00 PM		
4:00 PM		
Tuesday, August 25		
Noon		
1:00 PM		
2:00 PM		
3:00 PM		
4:00 PM		
Wednesday, August 26		
Noon		
1:00 PM		
2:00 PM		
3:00 PM		
4:00 PM		
Thursday, August 27		
Noon		
1:00 PM		
2:00 PM		
3:00 PM		
4:00 PM		
Monday, August 31		
Noon		
1:00 PM		
2:00 PM		
3:00 PM		
4:00 PM		
Tuesday, September 1		
Noon		
1:00 PM		
2:00 PM		
3:00 PM		
4:00 PM		
Wednesday, Sept. 2		
Noon		
1:00 PM		
2:00 PM		
3:00 PM		
4:00 PM		
Thursday, Sept. 23		
Noon		
1:00 PM		
2:00 PM		
3:00 PM		
4:00 PM		

Physics 293A

Confidence Survey



A major goal of this course is to help you (and future students) feel more comfortable about doing real scientific research. Thus, we need to measure that comfort level **at various points (~every 2 weeks)** in the semester, so that we can help design the course better.

You are just starting! It's ok/normal to not yet feel confident with many/all things. It's ok/normal for that confidence to go up and down as you encounter new challenges.

The World Needs More Critical Thinkers and Problem Solvers



Today's Agenda

- Confidence surveys and scheduling
- John's discussion on the interviews
- Introductions
- Syllabus debrief/motivation
- Pre-test
- Reading: background for your projects
- Next Time: What You Need to Know About Magnets



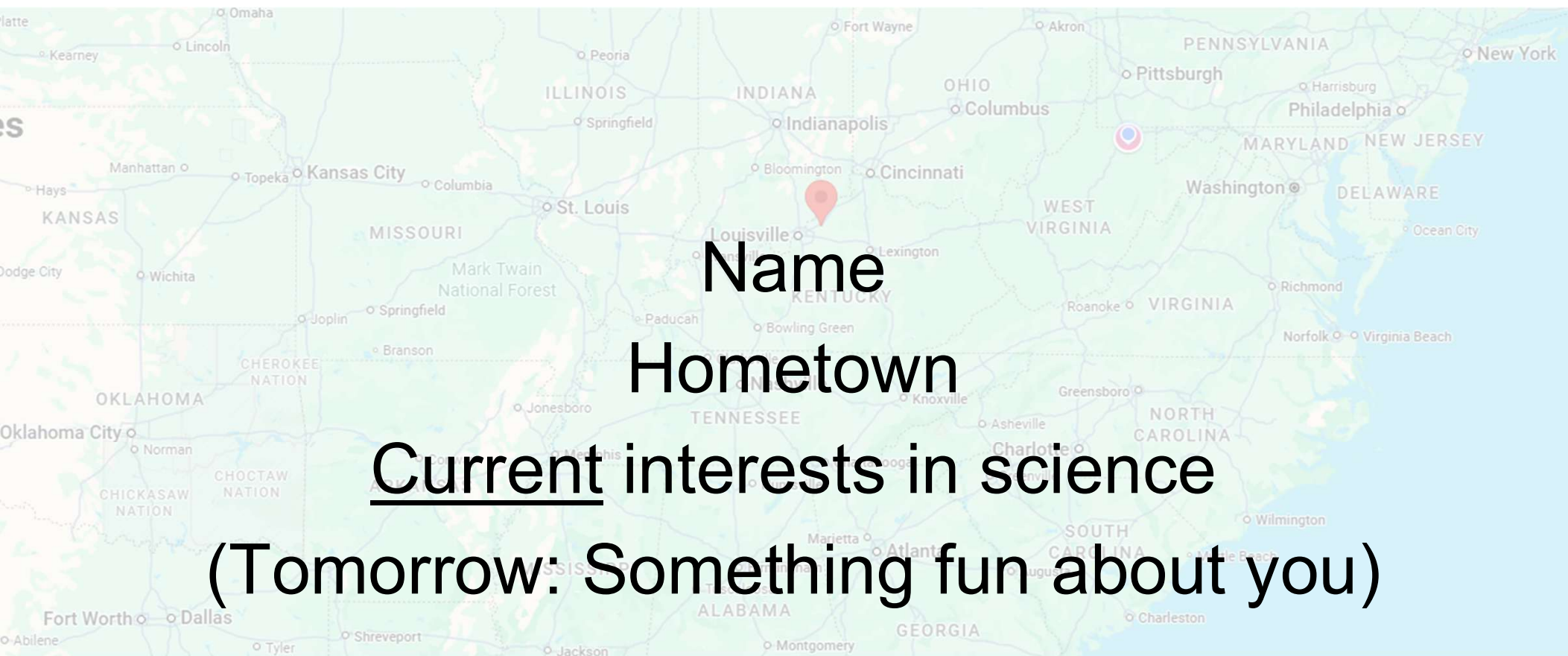
Who are your guides this semester?

- Prof. Micky Holcomb
- Prof. John Stewart (PER)
- Femi Akinrinola
- Raj Bhandari
- Robbyn Trappen (virtual)

- Past 293 students: Ivan, Jeremy, Dorian, Nate
- Optional: Faculty on certain projects
- Each other: don't underestimate peer help
- The internet can be helpful if you know how to look

Introductions

(If any of you are good at remembering names, I'll give you an opportunity to show off tomorrow.)



Name

Hometown

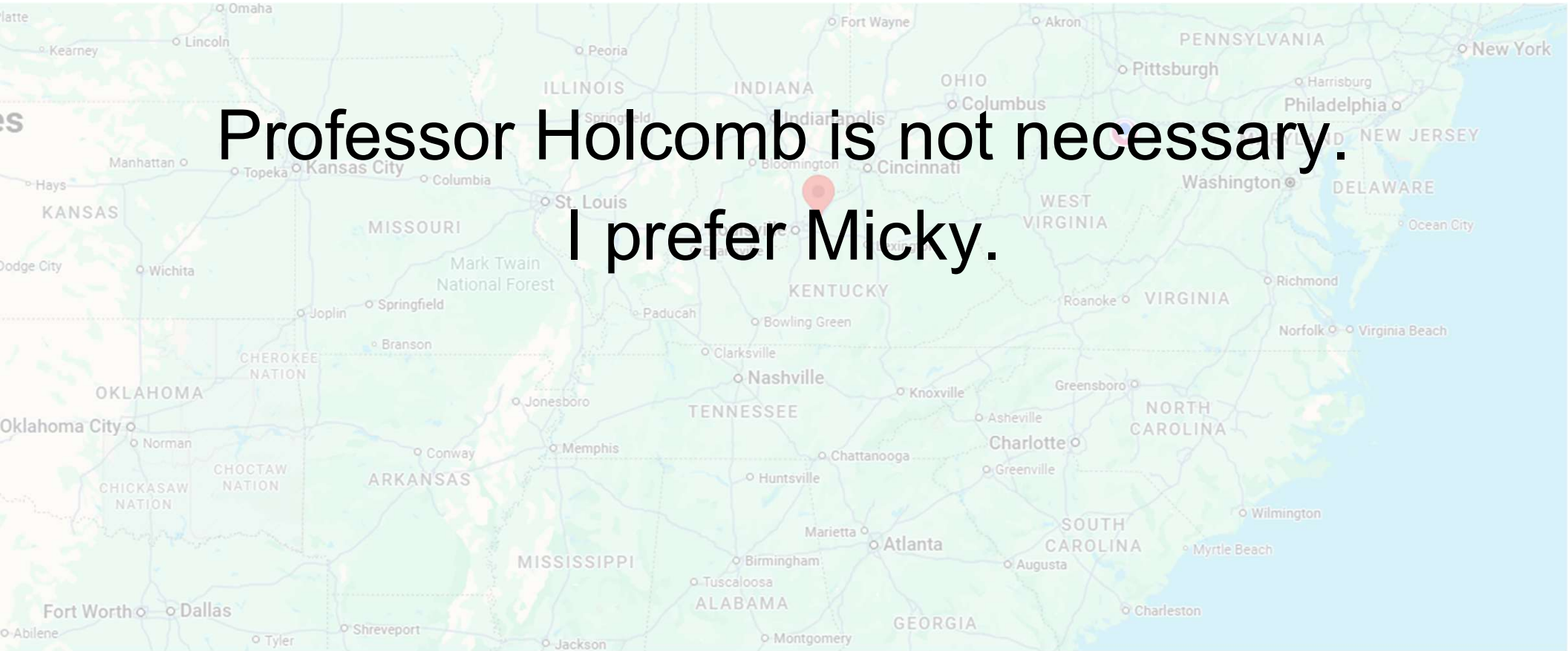
Current interests in science

(Tomorrow: Something fun about you)

My Official Name: Mikel (pronounced Michael) No, my parents didn't think I was going to be a boy.

Everyone calls me: Micky. You can too.

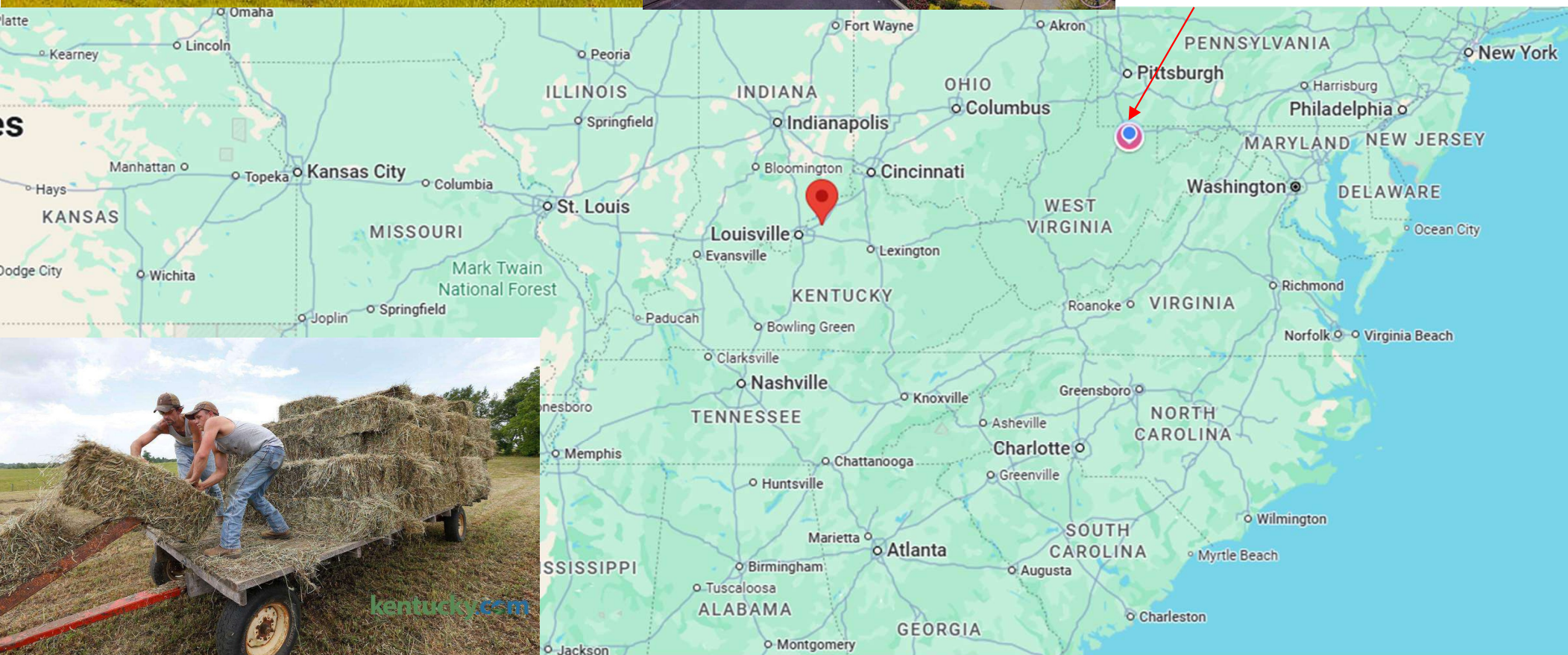
Professor Holcomb is not necessary.
I prefer Micky.

A map of the Eastern United States, showing states from Illinois to Virginia and North Carolina. A red pin is placed in central Kentucky, near the border with Tennessee. The text 'Professor Holcomb is not necessary. I prefer Micky.' is overlaid on the map.

Grew up in rural Kentucky



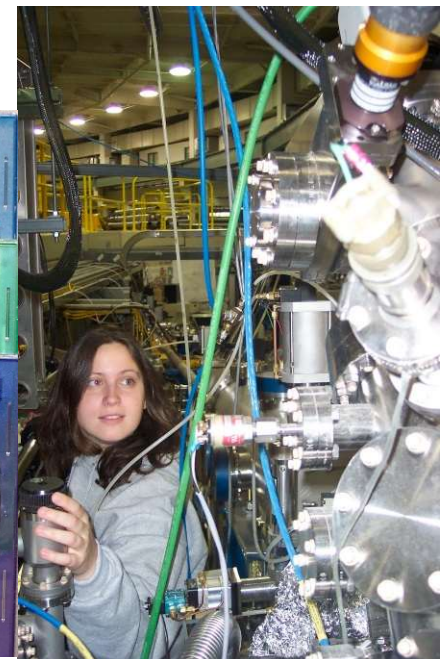
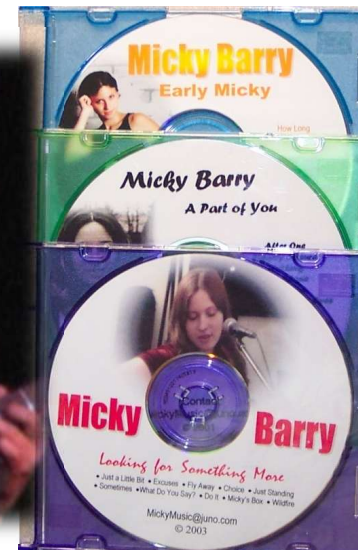
You are here!



About Your Professor



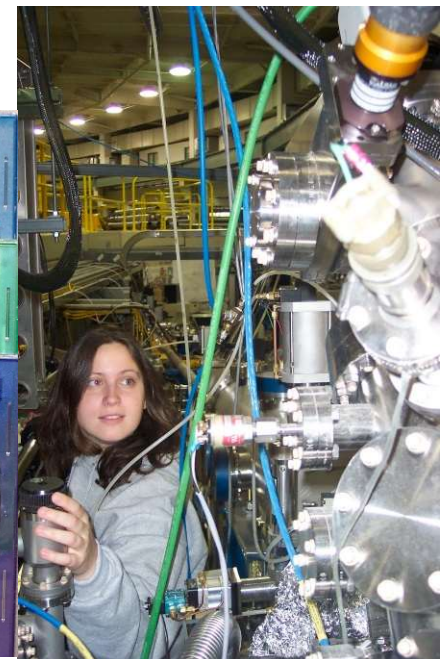
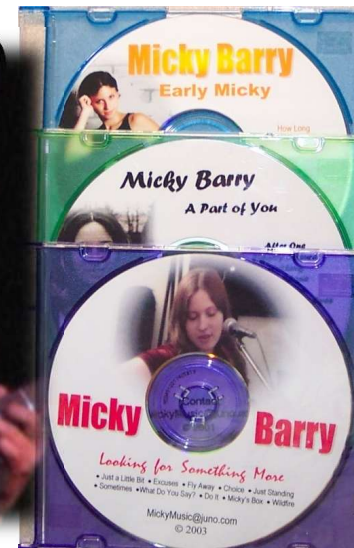
- Went to school at Vanderbilt and Berkeley
- Did graduate work at a national lab
- Did internship at IBM on quantum computing



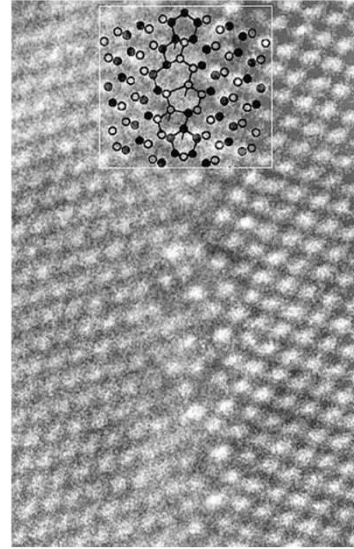
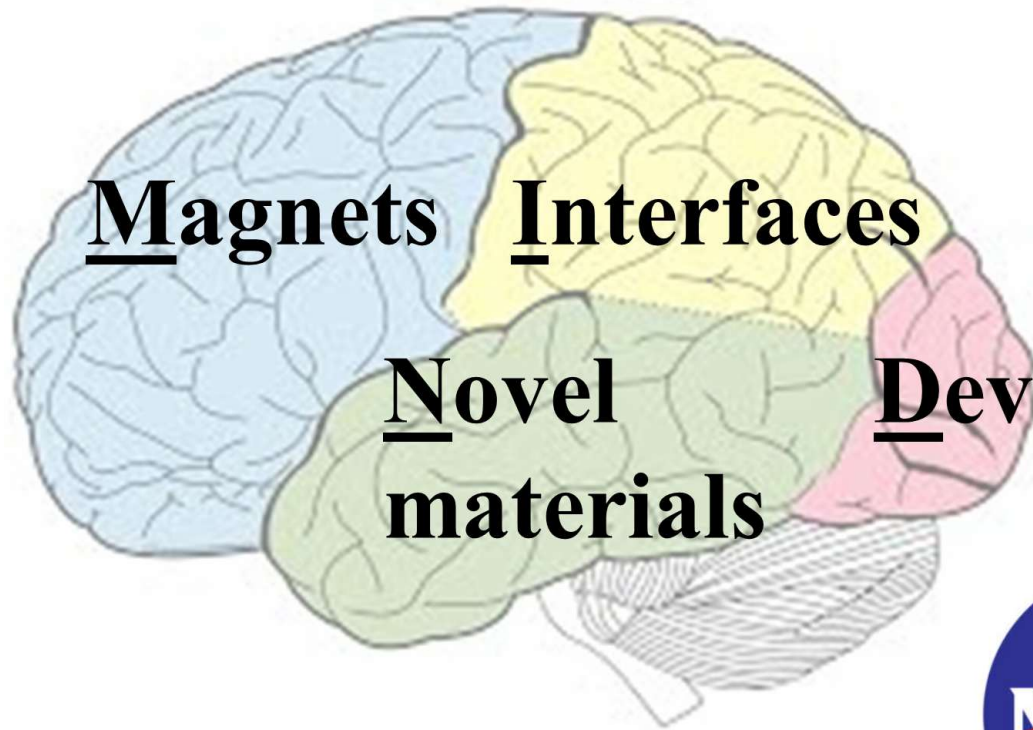
About Your Professor



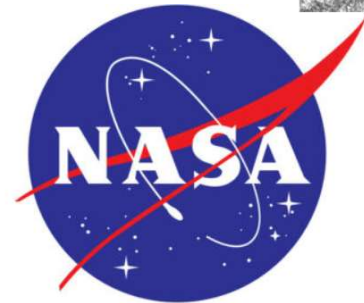
- Went to school at Vanderbilt and Berkeley
- Did graduate work at a national lab
- Did internship at IBM on quantum computing
- Toyed with an internet startup



Group Focus: Characterization of the MIND



using SOMA techniques



Standards

Optics

Magnetometry

Absorption

for chemical, field and time sensitivity

Leading \$4 Million with U. Delaware

PROJECT 1

BUILDING THE FUTURE OF MEMORY: MAGNETIC SWITCHING WITHOUT MAGNETS

Can you create computer memory that uses almost no energy?

We are developing the next generation of magnetic memory by using electric currents to switch magnetization—without external magnetic fields. This cutting-edge spintronics research could lead to faster, more durable, and ultra-low-power memory devices.

WHAT WILL STUDENTS DO?

- Grow advanced oxide thin films and heterostructures
- Measure magnetic properties
- Fabricate microelectronic devices (starting spring/summer)
- Study spin-orbit torques that allow electrical control of magnetism
- Use computational physics to predict and design new materials

WHY IS THIS EXCITING?

- Can electricity alone switch a magnetic memory bit?
- How do atomic-scale interfaces control magnetism?
- Can quantum effects lead to ultra-low-power computing?

PROJECT 2

DISCOVERING ALTERMAGNETS: A NEW CLASS OF QUANTUM MATERIALS

Altermagnets are a new class of materials with no net magnetization—but powerful spin-dependent effects. We are leading the search for new altermagnets and using tabletop experiments to reveal their unique quantum properties.

WHAT WILL STUDENTS DO?

- Predict new altermagnetic materials using advanced computational methods
- Image surfaces atom-by-atom using scanning tunneling microscopy (STM)
- Measure electronic band structures with photoemission techniques
- Use lasers to investigate ultrafast light-driven spin dynamics of quantum materials

WHY IS THIS EXCITING?

- What makes altermagnets different from ordinary magnets?
- Can light be used to control electron spins?
- How can these materials enable future quantum and spintronic devices?

Project 3: Quantum Dots and Quantum Memories: Controlling Spins with Light

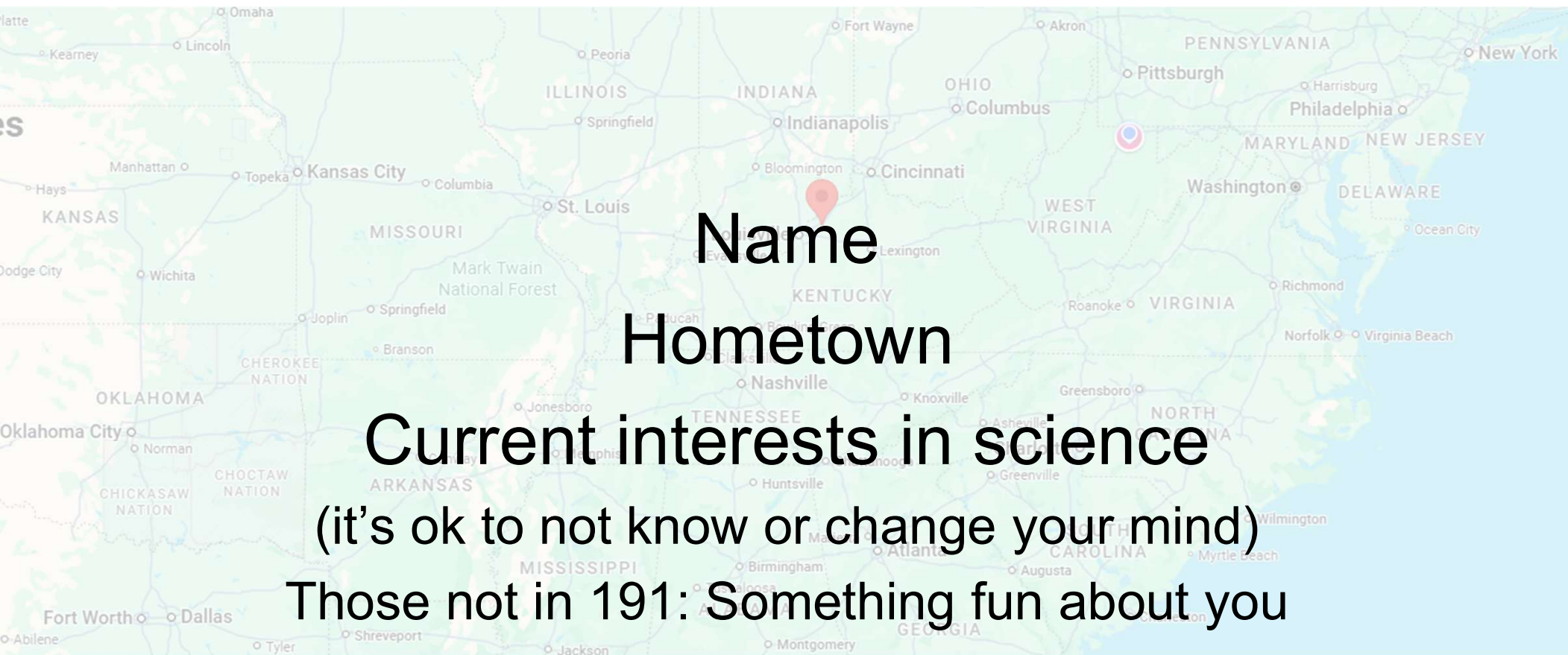
Quantum technologies could revolutionize computing, communication, and sensing. One promising approach uses tiny semiconductor structures called **quantum dots**, often described as "artificial atoms," to trap and control individual electrons using light. In this project, researchers are exploring how the spins of electrons inside quantum dots interact with the spins of rare-earth atoms. Understanding these interactions could lead to quantum memories capable of storing information for much longer than current technologies.

Project Leads: Holcomb

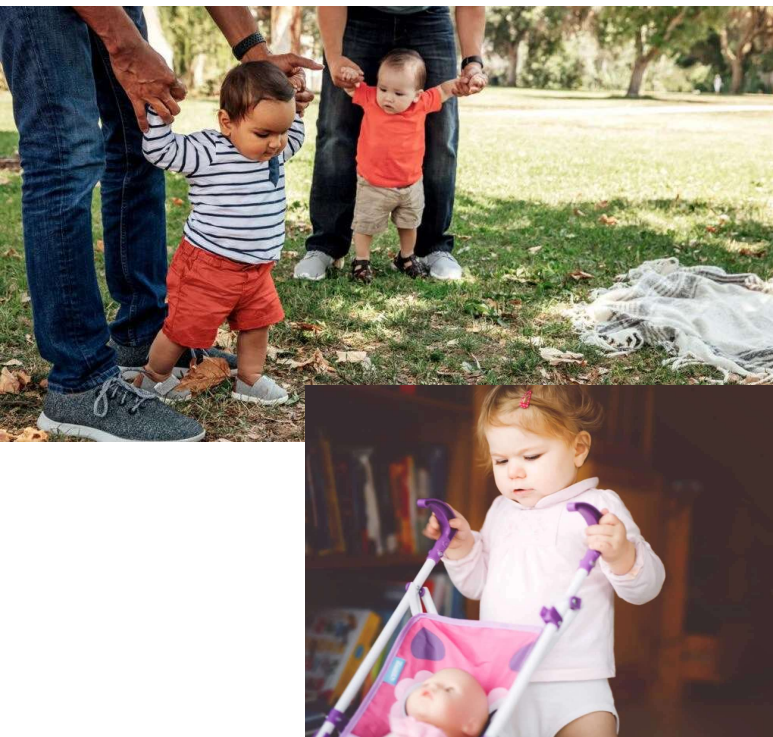
Mandal/Bristow

Flagg

Your Turn Introductions



I am a strong believer that you can contribute to research before you fully understand everything.



Do we learn the mechanism of walking before we walk?
Of course not. We are guided.
We make mistakes.

Our job is to guide you into learning how to guide yourself to learn things—a skill that will allow you to learn anything you put your mind to!

HOW TO TEACH YOURSELF ANYTHING

Stop using the same old tired excuse "I don't know how." In this age of extensive free or inexpensive information readily available at your fingertips, to remain ignorant is a choice.

by Megan James

1 READ ABOUT IT

Read books about the skill you want to develop, 15 minutes a day minimum. Change your mindset, learn from others' mistakes and gain new insight through the pages of each book.



2 TALK TO A MENTOR

Talk to someone with experience and success in the field or skillset you are interested in and learn from them. If this mentor decides to offer you time and advice, then clear your schedule and show up when he or she tells you to.

3 LISTEN TO PODCASTS

That frustrating 15-60 minute (or longer) commute to work can finally be useful for something! Listen to podcasts on the skill you want to learn about. Hundreds of experts have their own channels and are offering advice FOR FREE!



4 WATCH YOUTUBE VIDEOS

YouTube has a wide range of videos available to help you. Tutorials, interviews, recorded live shows, and even recorded seminars, conferences, and workshops. Yet another free resource at your disposal.

5 TAKE A COURSE

Udemy offers both free and inexpensive courses to educate on a wide variety of topics. There is sure to be a course on the skillset you are wanting to develop, and if there is not, then create your own!



6 JOIN A GROUP

Find some individuals who are a part of either a social or professional group which focuses on using this particular skillset. They can offer valuable advice, resources, and it's sure to be a fun time!

7 GET SOME EXPERIENCE

You have spent time educating yourself, now it's time to get your hands dirty. Put what you have learned to use and get hands on experience by applying the knowledge you've gained in this subject matter.



8 TEACH IT TO OTHERS

You have both knowledge and experience in your new found interest or field of study, now it's time to share it with others. Do not take what you have learned for granted and do not forget the value you got from the people that taught you.



The biggest benefit of an education in physics is it teaches you how to teach yourself anything.
(\$\$Highly marketable\$\$)

If you can learn physics, you can learn anything!

We can start to get good at this skill in this course!

What Will You Gain From This Course

Learning/practicing transferrable skills

- Finding/critiquing “known” information
- Problem planning, solving & documenting
- Networking and working with others
- Communicating complicated topics in written, oral and graphical forms

Opening opportunities

Build a cohort (matters more than you think)

NSF funded this because they care what helps. Let's tell them.

Feedback appreciated!

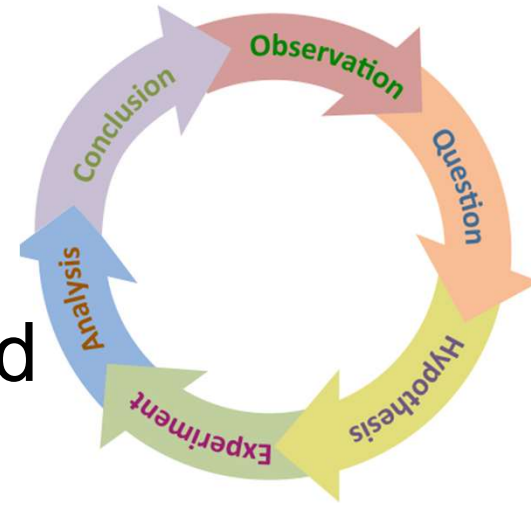
My Grading Philosophy

- While you aren't expected to know much coming into this class, you are expected to try to think critically. It's ok if you get things wrong, but you are expected to try! Your grade will reflect your effort.
- As long as you complete things and put in a good effort, it's extremely unlikely that you could get a C or worse. The difference between an A or a B in my classes typically comes down to if you completed things thoroughly and thoughtfully and followed the directions. There will be rubrics for major assignments.

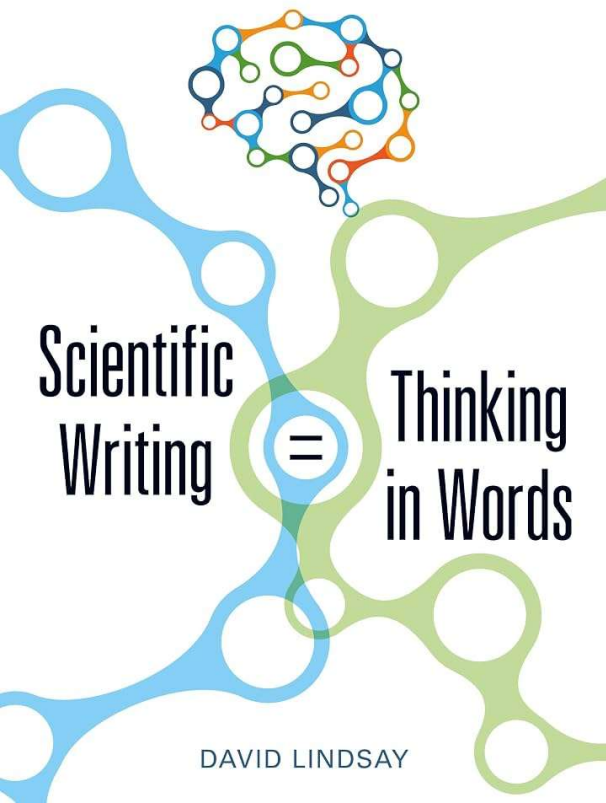
Brief Pre-Test

- Since our goal is to not only improve your confidence in certain skills but improve them, we have a couple of brief questions to see what you know.
- Answer to the best of your ability.
- It is totally acceptable to be COMPLETELY wrong about any of the knowledge questions. We just want to know what you currently think you know.

This Class is Designed to Help You Practice the Scientific Method



- **Ask a question:** Notice something and wonder why or how it happens.
- **Dig into related past research:** Look at past work or information to learn more.
- **Form a hypothesis:** Make an educated guess or a testable explanation for your observation.
- **Run an experiment:** Test your guess with a controlled test or procedure.
- **Analyze data:** Look at the results to see if they support your guess.
- **Share results:** Tell others what you found!



Research is a process, and not always so organized. You need to talk about your ideas to improve them. That means that your early ideas that you talk and write about will likely have some mistakes. That's ok, as long as you improve!



You WILL write up things before you feel ready. Writing IS thinking. It's ok. This is a safe place to work on improving!





Science:

If you don't make mistakes,
you're doing it wrong.

If you don't correct those mistakes,
you're doing it really wrong.

If you can't accept that you're mistaken,
you're not doing it at all.

Define Topic



Gather Sources



Experiment



Analyze



Write

The process isn't always linear. That's why we'll come back to skills sometimes.

Date	293 Topic	Homework (with goals color)	Topic	Sources	Experiment	Analyze	Write
18-Aug	Pre-Surveys; What is this Class About?	Partner/Scheduling Info					
20-Aug	Distinguishing Types of Magnetism	Reading 1					
25-Aug	Holcomb Group Discovery	Reading 2					
27-Aug	MOKE versus Other Magnetometry	Syllabus Read/Agree					
1-Sep	Project Planning: What Kinds of Magnetic Measurements						
3-Sep	Finding Published Papers Relevant to Your Project	Bring a Related Paper to Class					
8-Sep	Reading and Evaluating Papers	Reading on AI					
10-Sep	Best Practices with Lab Notebooks	Safety					
15-Sep	MOKE Hands-On Demonstration	Short video about light					
17-Sep	VSM Hands-On Demonstration	Important Papers. Why?					
22-Sep	How to Give Peer Feedback and Group Project Planning						
24-Sep	Planning Group Oral Reports and Peer Grading	Mini Reports (in class)					
29-Sep	Group Project Planning and Refinement	Reading on Quality					
1-Oct	Assessing the Quality of Materials	Project Proposal					
6-Oct	Best Practices with Graphing	Good/Bad Graphs					
8-Oct	Fall Break (No Class)						
13-Oct	Introduction to Excel: Spreadsheets, Graphing and Fitting						
15-Oct	Understanding and Processing Your Data	Lab Notebook Check-In					
20-Oct	Building a Story with Your Data When It Isn't Obvious						
22-Oct	Check-In and How Are Materials Grown						
27-Oct	How to Give a Good Talk						
29-Oct	Peer Evaluation of Lab Notebooks (Bring Notebooks)						
3-Nov	Election Day (Vote If You Can)						
5-Nov	Project Speed Dating: Share Your Project with Others	Graphs of Your Data					
10-Nov	Time for groups to Discuss Presentation/Data Planning						
12-Nov	Eight Minute Group Presentations	Presentations					
17-Nov	Eight Minute Group Presentations	Presentations					
19-Nov	How to Write a Good Abstract						
1-Dec	Ask Your Final Questions of Instructor, Partners or Class						
3-Dec	Discussion of Research and Scholarship Opportunities	Abstract & Notebook					

Perusall®

Every student prepared for every class

I can't wait to discuss this section in class!



Perusall is a **free** social annotation tool used to enhance student engagement with reading materials and facilitate collaborative learning. It allows students to annotate texts, articles, or videos together, fostering discussion and deeper understanding. This discussion is graded (guidance assignment to explain how).

Score	Grade	Feedback
3/3	100%	Wonderful!
2/3	95%	Good!
1/3	70%	Ok, but try to engage more. (on B/C border)
0/3	0%	I do not recommend. Reading early helps!



The process isn't always linear. That's why we'll come back to skills sometimes.

Date	293 Topic	Homework (with goals color)	Topic	Sources	Experiment	Analyze	Write
18-Aug	Pre-Surveys; What is this Class About?	Partner/Scheduling Info					
20-Aug	Distinguishing Types of Magnetism	Reading 1					
25-Aug	Holcomb Group Discovery	Reading 2					
27-Aug	MOKE versus Other Magnetometry	Syllabus Read/Agree					
1-Sep	Project Planning: What Kinds of Magnetic Measurements						
3-Sep	Finding Published Papers Relevant to Your Project	Bring a Related Paper to Class					
8-Sep	Reading and Evaluating Papers	Reading on AI					
10-Sep	Best Practices with Lab Notebooks	Safety					
15-Sep	MOKE Hands-On Demonstration	Short video about light					

Your first assignment is two reading assignments, due before next class. It is on Perusall, which you can find the link to on ecampus. The first assignment is just getting used to Perusall and how it grades. The second is actually reading about magnetism and commenting like Perusall wants you to. (Comments encouraged before 5pm night before so I can tailor class to questions.)

We will only use Perusall a few times.

Grade Breakdown

(A rubric will be provided)

Homework (rubric for graphing your work)	20%
Participation	20%
Lab Notebook Documentation	20%
(1/4 initial check-in, 3/4 at end)	
End of Semester Group Presentation	20%
Long Abstract of Experimental Results	20%

Research is different from typical classwork, and thus an easier grading scale is reasonable.

Grading scale: A (>85), B (70 - 85), C (55 - 70), D (40 - 55), F (<40)

Slides can be found at: Click on the magnetism class tab at

<https://community.wvu.edu/~miholcomb/phys191.html>



PHYSICS



HOME



191 CLASS



293 CLASS



ADDITIONAL
MATERIALS



BACK TO
RESEARCH

Main goals of the 293 class

Introduction to basic research principles, including literature searches, graphing and presentation
Introduction to sample growth and characterization
Practice in research and scientific communication (in both oral and written form)
Learning to seek feedback from peers and various advisors on how to improve research
Learning how to take ownership of your own research (AKA don't wait on the professor to bug you)

Fall 2026 Lectures

August 18 What you will be learning in Physics 293
August 20 Distinguishing types of magnetism
August 25 The novel magnetism our group discovered

Date	293 Topic	Homework (with goals color)
18-Aug	Pre-Surveys; What is this Class About?	Partner/Scheduling Info
20-Aug	Distinguishing Types of Magnetism	Reading 1
25-Aug	Holcomb Group Discovery	Reading 2
27-Aug	MOKE versus Other Magnetometry	Syllabus Read/Agree
1-Sep	Project Planning: What Kinds of Magnetic Measurements	
3-Sep	Finding Published Papers Relevant to Your Project	Bring a Related Paper to Class
8-Sep	Reading and Evaluating Papers	Reading on AI
10-Sep	Best Practices with Lab Notebooks	Safety
15-Sep	MOKE Hands-On Demonstration	
17-Sep	VSM Hands-On Demonstration	Important Papers. Why?
22-Sep	How to Give Peer Feedback and Group Project Planning	
24-Sep	Planning Group Oral Reports and Peer Grading	Mini Reports (in class)
29-Sep	Group Project Planning and Refinement	Reading on Quality

Feedback Scaffolding

How do the pieces fit?

Project Proposal

Early Lab
Notebook

INSTRUCTION

Practice connects
instruction to feedback

PRACTICE

FEEDBACK

Better feedback
drives revision

GROWTH

Better revision
drives growth

REVISION

What kinds of
measurements are
planned?

Why do you think this
work could be
important?

What do you think you
will learn about?

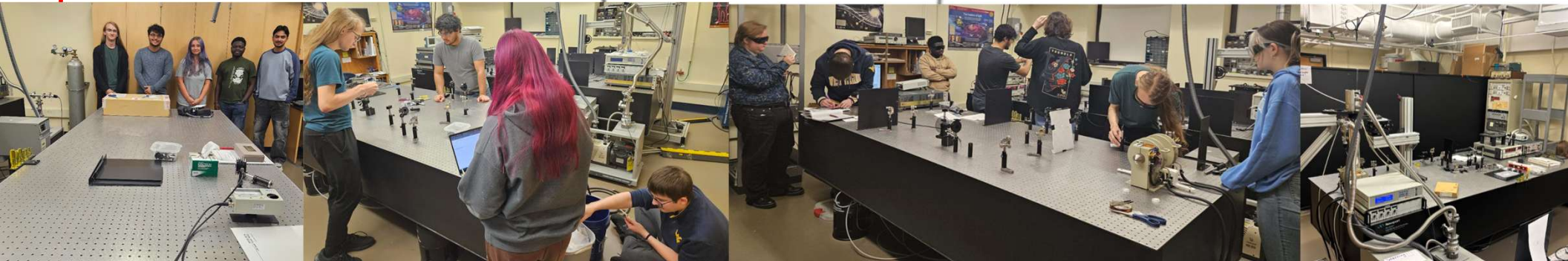
What material will you
measure? Why did you
pick this material?

Category

Introduction/
motivation/
goals

Figures
explaining the
background

Description of
the uniqueness
of the material



Any Questions about the
Syllabus/Course Goals?

Guiding You Through Research

- **Project proposal** lets you propose your project and get feedback.
- Most of this is critical for your **lab notebook background planning**, which gets turned in for additional feedback.
- Lots of people ask questions during experiment
- Later assignment: **Graph your data** to get more feedback on graphing
- Opportunities to present/discuss your research with peers and to professor/TAs

Define Topic



Gather Sources



Experiment



Analyze



Write

The process isn't always linear. That's why we'll come back to skills sometimes.

Date	293 Topic	Homework (with goals color)	Topic	Sources	Experiment	Analyze	Write
18-Aug	Pre-Surveys; What is this Class About?	Partner/Scheduling Info					
20-Aug	Distinguishing Types of Magnetism	Reading 1					
25-Aug	Holcomb Group Discovery	Reading 2					
27-Aug	MOKE versus Other Magnetometry	Syllabus Read/Agree					
1-Sep	Project Planning: What Kinds of Magnetic Measurements						
3-Sep	Finding Published Papers Relevant to Your Project	Bring a Related Paper to Class					
8-Sep	Reading and Evaluating Papers	Reading on AI					
10-Sep	Best Practices with Lab Notebooks	Safety					
15-Sep	MOKE Hands-On Demonstration	Short video about light					
17-Sep	VSM Hands-On Demonstration	Important Papers. Why?					
22-Sep	How to Give Peer Feedback and Group Project Planning						
24-Sep	Planning Group Oral Reports and Peer Grading	Mini Reports (in class)					
29-Sep	Group Project Planning and Refinement	Reading on Quality					
1-Oct	Assessing the Quality of Materials	Project Proposal					
6-Oct	Best Practices with Graphing	Good/Bad Graphs					
8-Oct	Fall Break (No Class)						
13-Oct	Introduction to Excel: Spreadsheets, Graphing and Fitting						
15-Oct	Understanding and Processing Your Data	Lab Notebook Check-In					
20-Oct	Building a Story with Your Data When It Isn't Obvious						
22-Oct	Check-In and How Are Materials Grown						
27-Oct	How to Give a Good Talk						
29-Oct	Peer Evaluation of Lab Notebooks (Bring Notebooks)						
3-Nov	Election Day (Vote If You Can)						
5-Nov	Project Speed Dating: Share Your Project with Others	Graphs of Your Data					
10-Nov	Time for groups to Discuss Presentation/Data Planning						
12-Nov	Eight Minute Group Presentations	Presentations					
17-Nov	Eight Minute Group Presentations	Presentations					
19-Nov	How to Write a Good Abstract						
1-Dec	Ask Your Final Questions of Instructor, Partners or Class						
3-Dec	Discussion of Research and Scholarship Opportunities	Abstract & Notebook					

Math Readiness

- Don't worry about it!
- This course is designed to be approachable with basic algebra skills
- However, if you'd benefit from exploring some basic applications of calculus at this point, that is an option (but not required)



"DON T WORRY ABOUT A THING,
EVERY LITTLE THING IS GONNA BE ALRIGHT"

- BOB MARLEY