Undergraduate Research Symposium

SMS Graduate Student Council

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ASU Biodesign A Photo by Mark Boisclair

A short vocabulary lesson

- **Principal Investigator** (PI) = head of a lab
- **Postdoc** = researcher who has a PhD and is getting additional training
- **Research Assistant/Associate** = someone paid to do research
- **Bench** = the space where experiments are conducted in a lab

https://www.newcomb-boyd.com/project/arizona-state-university-the-biodesign-institute-building-b/

Many career paths will benefit from research experience

- Positions in biotech/industry
- Medical research
- Academic research positions
- Graduate school in STEM
- MD/PhD programs
- And many more!

http://vanhorn.lab.asu.edu/Lab%20Information

There are two approaches to research

Computational

Experimental

“Wet lab”

“Bench work”

There are two approaches to research

Computational

- Involves developing models and simulations to understand natural systems
- Use computers and specialized software
- Involves some programming skills which can be learned
- Can be remote or in-person

Experimental

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Computational

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Experimental

- Similar to lab class, but outcomes are unknown
- Work at a bench in a lab
- Use computers for data analysis and collection
- Must be in-person

There are many opportunities to get involved in research as an online student

- Online Undergraduate Research Scholars (OURS)
- School Of Life Sciences Undergraduate Research Program (SOLUR)
- Rosetta Summer Internship Program (REU) (protein design and modeling)
- On campus labs that focus on computation

There are many opportunities to get involved in research off campus

- Tgen Helios Scholar Program
- Industry internships and Co-ops (LinkedIn, Handshake)
- Hospitals
- Barrow Neurological Institute

There are many opportunities to get involved in research on campus

- Barrett Honors program
- Course-based Undergrad Research Experiences (CUREs) – schedule of classes
- 4+1 program
- Research labs in Biodesign, Physical Sciences, and ISTB
- Research Experiences for Undergraduates (REU) funded by NSF, summers, stipends
- University jobs database
- Center for Negative Carbon Emissions (CNCE)

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Before we begin, let's dispel a few myths...

Myth

- All experiments work (or are supposed to work) like lab class
- Experiments have a definite time limit and will run according to plan

Reality

- Most of the time experiments fail and you spend a lot of time troubleshooting
- There are no time limits and nothing will run according to your schedule, ever

Before we begin, let's dispel a few myths...

Myth

- The PI (Principal Investigator) will train you
- Dishes and supplies will magically appear on a cart and there are elves who come in at night to clean

Reality

- A graduate student will most likely train you
- You need to prepare the supplies and keep the lab clean

Before we begin, let's dispel a few myths...

Myth

- Research is fast-paced. Eurekas! are common
- You will master protocols quickly

Reality

- Daily research is fast-paced, but progress is slow
- Mastery takes repetition

A good researcher loves science and has an open mind

- Curious and motivated to learn
- Willing to work hard and practice
- Passionate (or thinks they might be) about science and research
- Can handle disappointment and failure

- No one expects an undergraduate researcher to have a lot of experience so don’t let this discourage you!

iStock image

A good researcher is available to devote a lot of time to research

- Someone who can work long-term (at least a year)
- Someone who can devote AT LEAST 6-12 hours a week to research
- 2-3 days of 3 hours is better than 6 hours on 1 day
- Depending on the lab, may be require to write a thesis or present their research

Image from Freepic

Finding a lab on campus that suits your interests requires networking, research, and a little courage

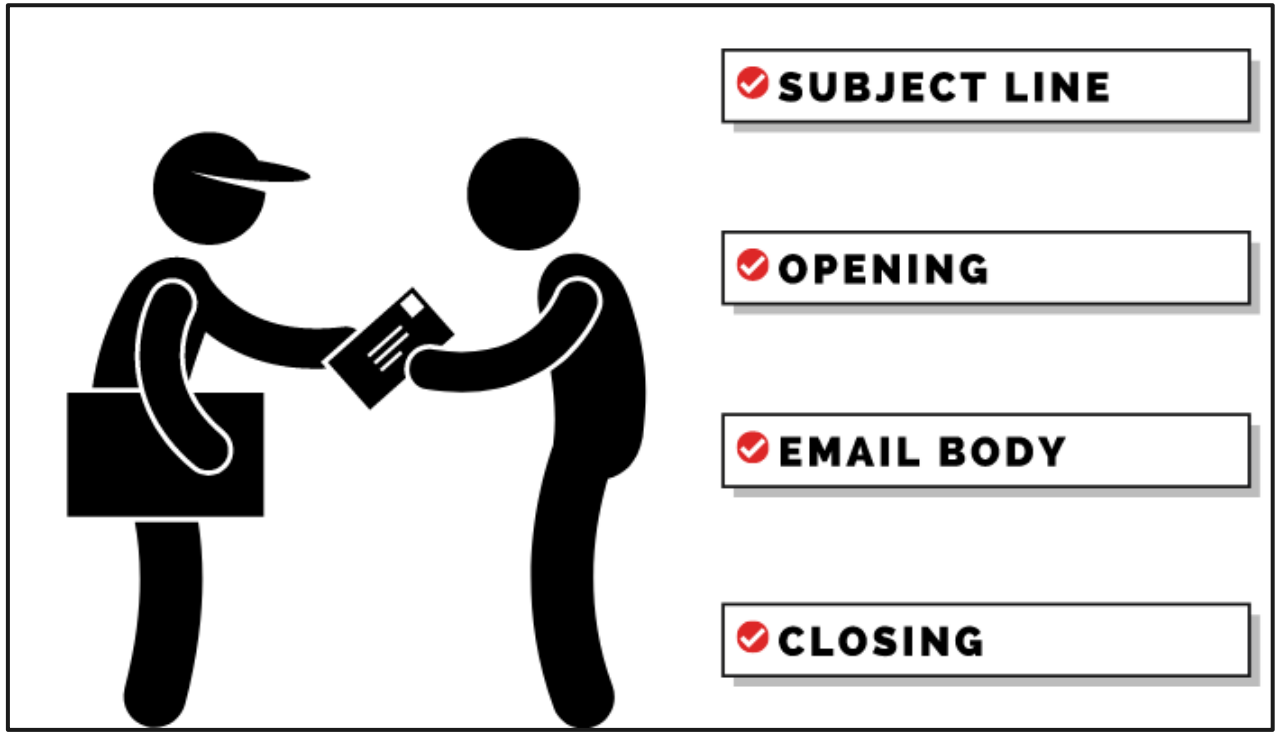
- Start early! The summer before your Junior year is ideal
- If a particular subject in class interests you, look for a lab doing research in that area
- SMS website or other unit websites
- Talk to your TA
- Reach out to your professors!

Photo from aias.org

A good first impression: An email to a PI must be professional

- Use complete grammatically correct sentences
- Include an organized CV as an attachment
- CV should include activities, classes, GPA, and potentially letters of recommendation/contacts for letters (only if available)
- Personalize your email – No messages in a bottle!
- Have a mentor look over your email and CV before sending!

Make a lasting impact with an organized email to the PI



https://uvaro.com/blog/email-etiquette-101

Your email opening is an introduction

- Subject line should be professional
- Begin with “Dear Professor or Dr. X”
- Start with an introductory 2-3 sentences of name, year, major/minor, Barrett? and career goals
- Remind PI of your relationship with her/him (if applicable)

The body of the email is your chance to make your case

- Long-term plans and how working in the lab fits your goals
- Weekly availability and when you can start
- Relevant classes, if applicable
- Why this group? What interests you in their work?
- Show that you have looked into the lab by reading one of their papers

You wrote an email, you didn't receive a response

- Don't take it personally
- Try another lab
- If you are REALLY interested in a lab and the PI doesn't respond. Take some time, read any recent papers and write a follow up email suggesting which of the projects you found interesting

Image from iStock

I’m in a lab, how can I make the most of my experience?

- Treat your time in the lab like a job. Keep your commitment and make sure you have a schedule
- Bring a notebook and write down all protocols and take pics (assuming PI is OK with it)
- Write down exactly what you did!
- Ask questions
- Take the initiative to read publications and learn about techniques

I’m in a lab, how can I make the most of my experience?

- “Pay it forward” by taking on lab chores
- Have an open mind and expect critical feedback
- Remember that you’re a beginner and you will make many mistakes
- Research is slow and filled with failure
- Stay organized
- Establish a relationship of trust with your mentor

A few more things to remember...

- Grad students and PIs are devote a lot of time and resources to train undergraduates. Be respectful
- No going off script without permission
- The more effort you give, the more you'll get out of it
- It takes a lot of repetition to learn the techniques
- Be open and thirsty to learn (Apply feedback and learn from it)
- You can do it! No one expects a new researcher to know anything

Would you like a copy of the slides and a list of resources?

https://forms.gle/kWfSQK4N2qxEcABx9

Our amazing panelists

Dr. Marcia Levitus

Dr. Kevin Redding

Dr. Barbara Munk

Dr. Matthias Heyden

Stephanie Donovan

Brooke Lovell

Beth Kolbaba-Kartchner

Resources

- UResearch https://provost.asu.edu/uresearch
- SMS undergrad research webpage https://sms.asu.edu/Undergraduate-Study/Research
- SMS Research Areas https://sms.asu.edu/Research
- Nature “A student’s guide to undergraduate research” https://www.nature.com/articles/d41586-019-00871-x
- Undergrad in the Lab https://undergradinthelab.com/node/115
- “How to choose the right lab: Advice from someone who didn’t https://gpchemist.acs.org/career-advice/how-to-choose-the-right-lab.html?sc=210601_proed_sc_fb_gpc_rightlab_od

More Resources

- REU information: https://www.nsf.gov/crssprgm/reu/reu_search.jsp
- Handshake: https://career.asu.edu/handshake
- University jobs database: https://career.asu.edu/handshake
- ASU Career Services: https://career.asu.edu
- SOLUR https://sols.asu.edu/solur
- OURS https://asuonline.asu.edu/
- Rosetta Commons Summer Internship Program https://www.rosettacommons.org/about/intern
- CNCE: https://globalfutures.asu.edu/cnce/join-our-team/

CNCE STAFF & FACULTY

Klaus Lackner: Professor and Founding Director

Lackner is the director of Center for Negative Carbon Emissions. His interest in self-replicating machine systems has been recognized by Discover Magazine as one of seven ideas that could change the world.

Matt Green: Associate Professor and Director

Green's research focuses on the design and synthesis of novel, ion-containing polymers to be used in applications such as water purification, carbon dioxide capture, nanocomposites, and micellar solution assemblies.

John Cirucci: Research Professor (FSC)

John Cirucci is a chemical engineer, process technologist and geospatial analyst, with emphasis in the energy and environmental domains. He is a Research Professor at Arizona State University and Chief Engineer for the ASU Center for Negative Carbon Emissions, developing CO2 capture and energy storage technologies.

Elham Fini: Associate Professor

Dr. Ellie Fini is an Associate Professor at Arizona State University. Fini's research focuses on bio-based construction geared towards synthesis, characterization, and application of biomaterials for sustainable development.

Marcus Herrmann: Professor

Herrmann is a professor of aerospace and mechanical engineering for SEMTE at ASU. His areas of expertise include fluid mechanics; modeling and numerical simulation of multiphase flows; model development and validation for atomization processes in turbulent multiphase flows; and numerical methods for discontinuous interfaces.

Gary Moore: Associate Professor

Gary Moore's group has research interests in chemistry to build nanoscale materials that are fundamentally interesting and address societal challenges.

Jennifer Wade: Assistant Professor

Dr. Jennifer Wade has worked in the areas of carbon capture, gas separation membranes, fuel cells and solid-state catalysis within the refining and automotive industry. She continues to collaborate in the area of carbon capture with the Center for Negative Carbon Emissions at Arizona State University, only now focusing on the separation of carbon dioxide from air.

Houlong Zhuang: Assistant Professor

Dr. Zhuang is an assistant professor in mechanical and aerospace engineering in the School for Engineering of Matter, Transport and Energy at ASU. Dr. Zhuang's current research interests are quantum simulations, machine learning, and quantum computing.

CENTER FOR NEGATIVE CARBON EMISSIONS

Advancing carbon management technologies that can capture carbon dioxide (CO_2) directly from ambient air

CNCE's long-term goal is to become the intellectual leader in this new field of sustainable energy infrastructure design

Join Our Team!

CURRENT PROJECTS

MechanicalTree™

Full scale installation of innovative passive direct air capture (DAC) technology.

Data Centers

Extracting excess heat generated in Data Centers to facilitate CO_2 capture.

AUDACity

Utilizing sorbent to capture atmospheric CO2 and delivering it to cyanobacterial pool to enhance growth.

SAPDAC

Developing a commercial-scale tree-farm while considering various geographic locations for energy optimization, techno-economic analysis, and life cycle analysis.

Sorbent Development

Synthesizing novel chemistries and testing various form factors of sorbent materials for carbon capture.

Carbon Management

Interdisciplinary cooperation researching carbon storage and utilization to manage atmospheric CO_2 concentration.

RESEARCH INTERESTS

Direct Air Capture (DAC) of CO2

Sorbent Development

Synthesis, Characterization, Computational Simulations, Testing, and Optimization of sorbents for DAC of CO2

CO_2 Utilization

Fuel development, concrete integration, steel plants, food and beverage distributions, waste water treatment facilities, cyano-bacteria cultivation, catalytic converstion to chemical feedstocks.

Systems Design & Analysis

Designing, modeling, simulating, testing and life cycle analysis of integrated systems for DAC and Carbon Management.

CO_2 Storage

Geologic storage, mineralization, cold storage of energy, impact surveys.

Business & Finance

Market Analysis and Projection, Grant writing, patents, corporate collaboration

Educational Outreach

Booths, Tours, Digital Fieldtrips, Lectures

Public Policy

Develping policy to deal with the Socio-Political aspects of DAC, Utilization and storage of CO2