CLEVELAND STATE UNIVERSITY · SUMMER RESEARCH EXPERIENCE

Doing Research: A Survival Guide

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Research Roadmap

01

Read the Literature

Build your scientific context

02

Ask the Right Questions

Hypothesis-driven research

03

Expand Your Toolkit

Embrace new & difficult methods

04

Communicate & Collaborate

Advisors, meetings, conferences

05

Persevere

Work through every roadblock

06

Tell a Compelling Story

Writing papers that captivate

01 | Read the Literature — Build Your Context

Which Literature?

Peer-reviewed journals

Science, Nature, Cell — plus field-specific (J. Neurosci., JACS, IEEE Trans., etc.)

Review articles first

Start with a high-quality review to map the landscape fast

Foundational papers

The "classic" papers everyone in your lab cites — ask your advisor

Preprints (arXiv, bioRxiv)

Cutting-edge but not peer reviewed — read critically

How to Read & Build Context

Start with a map

Read 1–2 reviews to understand the big picture before diving into primary papers

Follow the citation chain

Both forward (who cites this?) and backward (what does it cite?) — build the lineage

Read with questions

"What did they do, what did they find, what did they not explain?" — annotate actively

Keep a reading log

One-paragraph summary of each paper + how it connects to your project. Zotero is free.

Build your mental model

Sketch how findings across papers connect — this becomes your Introduction section later

02 | Ask the Right Questions — Hypothesis-Driven Research

What makes a good hypothesis?

T — **Testable**

Can you design an experiment to support or refute it?

F — **Falsifiable**

If you are wrong, the data must be able to show it

S — **Specific**

Vague predictions lead to uninterpretable results

G — **Grounded**

Rooted in existing literature — not invented from thin air

Curiosity → Question → Hypothesis

"I wonder if X affects Y" → "What is the relationship between X and Y?" → "Increasing X will increase Y because of [mechanism Z], as suggested by Smith et al. 2021."

Question Makeovers

"Does temperature affect enzyme activity?"

"Does increasing reaction temperature from 25°C to 37°C increase catalytic rate of amylase, consistent with Arrhenius kinetics, up to a thermal denaturation threshold?"

"Does exercise help mental health?"

"Does 30 min of aerobic exercise 3×/week reduce self-reported anxiety scores in college students over 8 weeks compared to a sedentary control group?"

03 | Expand Your Toolkit — Embrace the new and difficult

"I don't know how to do this yet."

Lab / Wet Skills

- Sterile technique & cell culture
- PCR, gel electrophoresis
- Spectroscopy & chromatography
- Microscopy (confocal, fluorescence)
- Animal or patient protocols

Computational Skills

- Python or R for data analysis
- Statistics & visualization
- Bioinformatics pipelines
- Simulation / modeling
- Version control (Git/GitHub)

Scientific Reasoning

- Experimental design & controls
- Statistical power & sample size
- Identifying confounders
- Peer critique (journal clubs)
- Reproducibility practices

04 | Communicate & Collaborate — Put Yourself Out There

Your research success strongly depends on how well you communicate.

Your Advisor

- Meet weekly — come with a written update
- Share results promptly, good or bad
- Ask specific questions, not "what should I do?"
- Follow up on action items before next meeting

Lab Group Meetings

- Volunteer to present early — do not wait until the end
- Show raw data, not just polished figures
- Engage when others present; ask thoughtful questions
- Take notes on feedback and address them

Conferences & Symposia

- **USRA students have a poster session in September**
- Poster presentations: practice a 3-min pitch
- Talk to strangers — introduce yourself at every coffee break
- Collect business cards / LinkedIn connections

Building Collaborations

- Collaborators provide techniques you don't have
- Be generous: offer your skills in return
- Co-authorship grows from relationships, not emails
- Stay in touch after the summer ends

The collaborations you start this summer may define your research agenda for years.

05 | Perseverance — Work Through Roadblocks

"If you're not failing, you're not pushing hard enough." — Unknown

Common Summer Roadblocks	How to push through
Experiment won't replicate	Check controls, reagents, protocol — document every variable
Equipment failure / downtime	Use the time to read, analyze existing data, or learn a new tool
Data doesn't support hypothesis	Negative results are still results — investigate why
Overwhelming confusion	Break it into one small question you CAN answer today
Imposter syndrome	Everyone feels this. Share it with a labmate — they do too
Advisor seems unavailable	Send a concise email with 3 specific questions. Request a slot.

The researchers who make discoveries are not the most talented — they are the ones who kept going.

06 | Tell a Compelling Story — Writing That Gets Published

Technical rigor gets your data; storytelling gets your paper read.

Introduction — *The Setup*

Why does this matter? What is the gap? What is your central question?

Methods — *The Process*

The reproducible recipe — precise, complete, no ambiguity. Others must be able to repeat it.

Results — *The Evidence*

What happened? Show the data cleanly. No interpretation — let the figures speak.

Discussion — *The Meaning*

So what? Connect findings to literature, acknowledge limitations, open future doors.

Abstract ★ — *Written LAST*

150–250 words. One sentence on why, how, what you found, and what it means.

What makes papers compelling?

One clear message

A paper should answer one focused question. If you can't state the take-home in one sentence, revise.

Logical flow

Each paragraph earns the next. A reader should never wonder "why are they telling me this?"

Figures tell the story

A reader who only looks at your figures should understand your paper. Design them accordingly.

Cut ruthlessly

Every sentence that doesn't serve the argument weakens the paper.

Be precise

Be specific, not vague. Not "results improved" — "sensitivity increased 3.2-fold ($p < 0.001$)."

Start writing the day you start experiments. A methods section written in real-time is infinitely better than one recalled months later.

A Summer Action Plan

Weeks 1–2 (Orient)	Weeks 3–6 (Execute)	Weeks 7–9 (Produce)	Week 10 and beyond (Communicate)
› Read 10+ key papers; build context map	› Run experiments; document everything daily	› Analyze data; make publication-quality figures	› Present your findings at the research showcase
› Learn the lab protocols and safety rules	› Bring preliminary data to group meeting	› Schedule a mid-point advisor feedback session	› Draft an abstract or short report
› Clarify hypothesis with advisor in writing	› Troubleshoot boldly — log every change made	› Start thinking about what to include in your poster	› Discuss continuation / authorship with advisor
› Set up your lab notebook & Zotero library	› Begin drafting Methods section NOW	› Identify gaps; design follow-up experiments	› Stay connected — science runs on relationships

Keep a daily lab notebook. At the end of the summer, it will be extremely valuable.

Recap: Six keys for guiding your growth as a researcher

01

Read the Literature

Know the field deeply before you add to it. Build your mental map.

02

Ask the Right Questions

Hypothesis-driven research produces interpretable, publishable results.

03

Expand Your Toolkit

Say yes to every difficult method. Pain is weakness leaving the body

04

Communicate & Collaborate

Present early, present often. Science is built on relationships.

05

Persevere

Roadblocks are not failures — they are the job. Keep going.

06

Tell a Compelling Story

Great science poorly communicated is forgotten. Learn to write.

"The secret of getting ahead is getting started." — Mark Twain