Lab Culture

- Take Notes: You won’t remember everything
- Document everything
  - Readable
    - Don’t erase changes just place a line through so you can remember why you made the change
    - If you can read it later why did you take your notes
  - Easy to understand
    - Number pages
    - Stay organized
- Notes for your notes
  - Date every entry
  - Make side notes if you write something that you didn’t quite understand
- Define terms
  - Keep track of terms that you will use often and have the definition in your own words for future reference.
- Understanding Rules and Expectations
  - Safety
    - Always be aware of your surroundings
    - Lab Safety is the first thing learned in each lab
    - It’s for your own safety
  - Accountability
    - Be responsible: you’re doing this because you want to
    - Be self motivated and able to work independently
- Promote teamwork
  - You can get more done as a team that works well together
  - A team is only as strong as its weakest link
- Productivity
  - Keep working
  - Never sacrifice quality for quantity or speed
What Is Research?

- “Investigation of an idea using the scientific method.”

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Identify and develop your topic

- Finding a Research Topic
  - What interests you?
  - What is relevant?
  - What does your mentor want you to research?
  - Interest into a Topic
  - What topics in your field relate to your interest?
  - Develop your idea into a topic with a mentor.
  - Search for similar topics being researched.

- Develop a Question
  - Start thinking about the who, what when and where?
  - Focus on the How and why?
  - Begin writing questions that your research could answer.
  - Ask yourself the Questions
  - Who cares?
  - Why would others think it’s a question worth asking?
Question to Topic

- Develop the answers
  - Name your topic....
    - ‘I am trying to learn about______.’
  - Add an indirect question.....
    - ‘I am studying/work ing on______’
  - Because I want to find out
    - who/what/where/whether/why/how___’

- Example
  - I am studying the effects of synthetic jet flow on an airfoil trailing edge.
  - Because I want to find out if synthetic jets can prolong an airfoil stall.
  - In order to make more efficient turbine engine blades.

Significance

- Ask a question that will solve a problem
  - Is the problem of current interest?
  - Is it likely to continue in the future?
  - How large is the population that is affected by the problem?
  - Would research findings lead to some useful change?
  - Is there evidence or support for continued research?
  - What current research is being completed in a similar problem?

Literature Survey

- Don’t start from nothing
  - Be a smart researcher: use the library, internet, and articles to find information.
  - Types of information
  - When looking through literature take note of the researchers involved, time period and credibility.
  - Look for current similar topics as your topic.
  - Find articles that can give examples of the best ways to do things to prevent the same mistakes they did.
• Use your literature survey to find more literature
  ◦ Most of the time researchers reference other researchers
  ◦ Document everything
  ◦ Organize your Literature survey so you can refer back as needed during the research process.
  ◦ Cite Sources: Good preparation for final research report.
  ◦ Literature Survey is a continuous process throughout the research process

Set Goals

• What are the variables?
  ◦ Independent variables
  ◦ Not changed by other factors
  ◦ Can be controlled
  ◦ Dependent variables
  ◦ The outcome of another factor could change this

• What will be measured?
  ◦ Ex: Lift, Drag, Temperature, Growth, divergence, convergence

• What relationships will be examined?
  ◦ Ex: Angle of Attack vs. Lift, Decay vs. Time, Convergence vs. Iterations

• Set yourself a timeline with deadlines
  ◦ Think back to your problem statement and question you want to answer.
  ◦ Plan monthly weekly and daily deadlines

• Time management
  ◦ Don’t wait till last minute
    ◦ Break down projects with time goals

Theoretical Methods

• What equations will be used?
  ◦ Governing equations
    ◦ Simplified methods
    ◦ Assumptions

• Organize calculation
  ◦ Excel
    ◦ Visual Basic Coding
  ◦ Matlab
  ◦ Write all equations out to verify correctness
• What are the physics behind the issue?
  ○ The relation between theory and experiment
    • Simplified methods – Ex: Laminar, Turbulence
• Once the theory is found is it testable
  ○ Is it physically not testable
  ○ Micro scale
  ○ Too big
  ○ Not costly
• Some research can’t be tested

Experimental Methods

• Things to consider
  ○ What experiments will be ran?
  ○ Where will you run them?
  ○ When will you be able to?
  ○ How long will it take to get sample data?
  ○ Who will be conducting experiments?
  ○ Set up
  ○ Materials
  ○ Manufacturing
  ○ Assembly
  ○ Data Acquisition systems

• Costs
  ○ From setup to final time spent
  ○ Who will budget the finance?
  ○ How will you get Funding?
  ○ Running experiments
  ○ Configurations
    • Time management
  ○ Test Plan
    • Plan of action
  ○ Is data valid?
    • Is there a control test
Data Analysis

- Is the data collected acceptable
  - Outliers
- What type of graph is needed to express the results?
  - Ex: Pie chart, Line graphs, Log
  - Are you able to graph your relations in your goals?
- What was the conclusion?
  - Was your question answered?
    - Does the problem statement need to be changed?
  - How well does the experimental match the theoretical?

Does the problem statement need to be changed?
- Did you consider all the variables?
  - Is an iteration necessary?
  - Do you need to rethink the methods?
  - Did you consider the error?
- What type of error is being produced?
  - Controlled error
    - Bias
  - Acceptable error
    - Within a range
- Were all the goals met?

Communicate Results

- Final Report
  - Course Requirement
  - Master’s thesis
  - Competitions
  - Publication in a Scientific Journal
  - Follow Scientific journal writing standards
  - AIAA technical journal formatting
  - Presentation
  - Classrooms
  - Campus
  - Thesis Defense
  - Competitions