THE SCIENCE OF GOAL SETTING

SUMMER UNDERGRADUATE RESEARCH PROGRAM 2018
WHY SET GOALS?

• Research is less structured than classes, so it is critical to set your own goals.
• Effective goal setting helps people achieve more and feel better while doing it.
  – **Focuses** your activities.
  – **Increases motivation** towards achieving specific aims.
  – Makes you more likely to **work through setbacks**.

PRINCIPLES OF EFFECTIVE GOAL SETTING

- Keep them few in number.
- Make them SMART: specific, meaningful, actionable, realistic, and time-bound.
- Write them down and review them frequently.

S — SPECIFIC

• Concrete rather than vague – if uncertain, ask your mentor!

• Gives a clear path which increases persistence and decreases feelings like anxiety, disappointment, and frustration.

• Examples:
  – “Understand quantum field theory.” → “Be able to solve problems from chapters 1-3 of Peskin and Schroeder.”
  – “Learn about astrophysics research” → “Carefully read a review paper and be able to explain its main ideas.”
  – “Do your best, work hard.” → “Every morning, come up with at least one goal for the day and try to achieve it.”

M - MEANINGFUL

• Goals are most effective when they are meaningful and have valuable outcomes for you.
• Meaningful goals increase sense of ownership, engagement, and satisfaction.
• This is hard. This is also what you’re trying to discover.
• If you find it – whether it’s in physics research or something else – go for it!

A - ACTIONABLE

• Create actionable goals as steps to accomplish a desired outcome.

• Shown to improve achievement, motivation, and belief in one’s own ability.

• Examples:
  – Outcome: “Fabricate a specific device.”
    Action: “Get trained on the evaporator in the cleanroom.”
  – Outcome: “Decide whether I want to go to grad school.”
    Action: “Talk with a lot of graduate students.”

R - REALISTIC

- Too hard, and people tend to give up.
- Too easy, and it’s not as rewarding when achieved.
- BUT, especially difficult to identify ambitious but attainable goals in research – seek your mentors’ advice.
- Example:
  - “Publish a research paper by the end of the summer.”
  → “Write an abstract summarizing your results.”

T - TIME-BOUND

• Identify both long-term and short-term goals.
  – This increases motivation and sustains persistence.

• Set an approximate timeframe for your goals.
  – Makes goals more realistic and increases motivation.

Goal: Create fake data that is ‘genuinely random’ and sufficiently imitates the 3-79 keV spectra from a high-energy astrophysical source

- Consider random generator methods
- Use existing tools to create simple, first-order fake energy spectra from which to generate random uncorrelated data
- Extend to second dataset
- Take into account valid time intervals, energy distribution, and uncertainties
- Import results and write documentation in Python, perhaps in a Jupyter notebook
EXAMPLES

Goal: Construct and characterize an optical dipole trap using two focus tunable lenses with automatic control via computer

- Construct and test current controllers
- Use Python code to communicate with lenses
- Measure temperature sensitivity of focal length of lenses. Determine and implement means of temperature stabilization/compensation
- Get 1064nm laser and AOM up and running; test setup with 1064nm light and make sure it matches theory
- Write program for automatic control, accounting for temperature effects
- Test and calibrate program
- Integrate with rest of experiment
EXAMPLES

Goal: Learn and implement spin coherent state path integrals

- Read about spin coherent state path integrals from Shankar, Eduardo, and understand its domain of applicability
- Apply the approach to Ising chain, and reproduce spin wave dynamics
- Apply the approach to qubits model in large S limit and maybe use WKB to get an expansion in 1/S of the energy levels
PRINCIPLES OF EFFECTIVE GOAL SETTING

• Keep them few in number.

• Make them SMART: specific, meaningful, actionable, realistic, and time-bound.

• Write them down and review them frequently.

REFERENCES


