Goals, Hypotheses, Research Questions, and Project Objectives

A. Three ways to begin an academic research project:

1. A goal statement or statements
2. An hypothesis or hypotheses
3. Research questions

1. **Goal:** A *general* statement of a project’s ultimate purpose. It can be open-ended, idealistic, even visionary.
   - *Our goal with this project is to improve the teaching of STEM subjects (science, technology, engineering, mathematics) to undergraduates.*
   - *This project will deepen our understanding of the effects of global climate change on populations of saltwater plankton.*
   - *This study will result in the first complete database for the assessment of the effects of toxic metals on human reproduction.*
   - *We seek to understand how cell division and differentiation are regulated by a myriad of extracellular and intracellular signals.*
   - *The research team will develop an analytical framework for classifying the learning styles of middle school students.*

2. **Hypothesis:** A specific, testable *assumption or conjecture* that the research data are expected to support. (Note: Whether the data do or do not support the hypothesis is of equal scientific importance!)
   - *We will test the hypothesis that large neurons are selectively destroyed in Alzheimer’s Disease by measuring the sizes of ganglion cells in retinas of AD patients compared with those in control groups.*
   - *We hypothesize that increased consumption of Omega-3 seafood, fresh fruits and vegetables will reduce the progression of cognitive impairment in patients diagnosed with Alzheimer’s Disease.*
   - *Soldiers exposed to live combat will exhibit higher levels of domestic violence post discharge.*

3. **Research Questions:** inquiries related to lack of knowledge in an important area of research, answers to which are sought through the research design.
   - *Are there common lifestyle traits among those suffering from diabetes in this region?*
   - *Do local physicians address these traits in prescribing treatment and follow up regimens?*
   - *Are there significant variations in standards of practice among physicians?*
   - *If so, is there a rational basis for these variations?*
B. Project objective: A specific, measurable, benchmark, milepost, or outcome achieved in moving toward the goal.

- Whether starting with a goal, an hypothesis, or research questions, the next step is to formulate the project's objectives
- Most successful research designs are driven by 2 – 4 objectives
- Active verbs are key to writing strong objectives
- Upon completion of the final objective, the goal should be obtained (or at least major progress should be achieved)
- In health-related research, objectives are often referred to as “Specific Aims” (US National Institutes of Health)
- Four kinds of objectives:
  1. Behavioral – a human action is anticipated
     Rehabilitation patients receiving dual treatment modalities will learn to walk without the use of mechanical support
  2. Performance – a specific time frame and proficiency level for a particular behavior
     Upon completing the new curriculum, at least 75 per cent of participating students will pass the certification examination
  3. Process – a specific action step in the research plan
     We will design and test three new modules for teaching economics to undergraduates
     Utilize a modeling approach to characterize pharmacokinetic data influencing insulin dosage among the target population
     Identify the primary means parents use to discipline their children, and rank them by level of violence
  4. Product – A tangible item will result
     A video illustrating our research methods will be posted on the Center’s web site
     “Biology in a Box” teaching kits will be distributed to six rural schools in the county