Main point: How to find a good research question.

Goal: A difference (an increase in knowledge) that makes a difference (in the world)
   - if we found X, how would it affect field Y? E.g.,
     - what particular theories would be supported or disproved?
     - what particular practices would be affected?

1. Finding a Particular Question / Problem (Generation phase)

   Evolutionary Design 1: Start with a particular problem, and make more general
   1. get examples from the world around you – why is X the way it is?
   2. look at what has been done – what kinds of studies
      - systolic process – keep modifying/simplifying parts, and see what happens
         o may need to iterate: modify/simplify some more – but try to stay with topic

   Evolutionary Design 2: Start with general issue, and narrow it down to specific experiment
   1. start with an interesting (vague, general) question
   2. add distinctions / restrictions that mean something, that can eventually be tested. E.g.,
      - consider only one aspect of the issue
      - break it down into parts
      - systolic process – keep adding distinctions / restrictions
         o may need to iterate: restrict/shift focus some more – but try to stay with topic

In both cases, try to remove irrelevant factors (variables), while keeping something of interest
   - danger: denaturation – lose the essence of the issue

In both cases, ultimate goal is to have a question and a problem (and eventually, an answer)
   - question—external aspect (cf Marr - computational level)
   - problem—internal aspect. (cf Marr - representational level)

   These can be evolved simultaneously. Start with one, and the other emerges
   - systolic process
2. Quality of results: MAGIC Criteria - see Abelson

1. Magnitude
   - how much of a difference is found (in terms of data)
     o how big the effect is (absolute difference; effect size)
     o reliability of the effect (statistical significance)

2. Articulation
   - how many useful distinctions / details (bits) can be made
     o what can be said about the nature of the relationship - clear description
     o what can be said about its interactions (e.g. dependence on various factors)

3. Generalizability
   - how widely applicable are the conclusions;
     o range of general conditions it applies to
     o the range of people/animals/agents that it applies to

4. Interestingness - amount of change in people’s minds
   - surprise + importance
     o surprise = degree to which existing beliefs are (unexpectedly) changed
     o importance = how many theories or practices need to be changed

5. Credibility (Compatibility)
   - how believable are the results
     o fit with knowledge about behavior of world (phenomenal)
     o fit with most existing theories about the world (theoretical)
     o internal consistency
   - how believable is the methodology
     o compatibility with existing analysis techniques
     o should be as sound as possible; minimal assumptions
     o logically airtight; all assumptions are believable
Real-World Segment: Undergrad research opportunities

1. what it can do
   a. how to find a lab to work in (incl. look at CSS? CSSS?)

2. how to assess a lab
   a. how to evaluate prof’s style (3 factors) - each a continuum
      i. risk-taking or not
      ii. how effective (w-factor) – Google Scholar
      iii. how controlling (micro-management vs. leave alone)
   b. talk with other lab members

3. what to expect (roles, lifestyle)
   a. two different types of setup - hierarchy (limited) vs. apprenticeship
   b. work with grad student / postdoc

4. what to watch out for
   a. conflicts in style
   b. exploitation