00: **Introduction**
January 6, 2012

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Hard work

Research plan
and goals

Ph.D. process paths

Thesis
Publications
Career

Knowledge
(courses, literature, etc.)
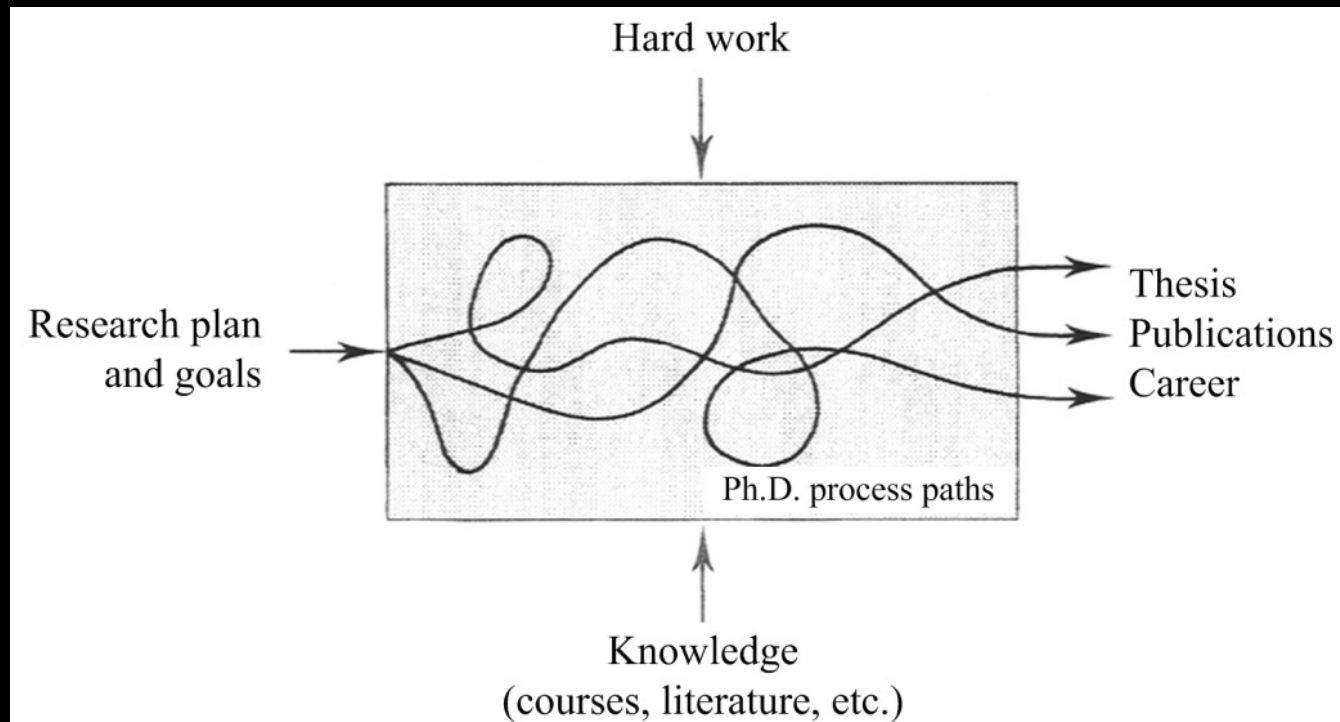
10,000 hours!

- 5 years of 40h/week doing research (estimate)
- May not include
  - Classes
  - Recreation
  - Distractions…

A common theme that appears throughout *Outliers* is the "10,000-Hour Rule", based on a study by Anders Ericsson. Gladwell claims that greatness requires enormous time, using the source of The Beatles' musical talents and Gates' computer savvy as examples.[3] The Beatles performed live in Hamburg, Germany over 1,200 times from 1960 to 1964, amassing more than 10,000 hours of playing time, therefore meeting the 10,000-Hour Rule. Gladwell asserts that all of the time The Beatles spent performing shaped their talent, "so by the time they returned to England from Hamburg, Germany, 'they sounded like no one else. It was the making of them.'"[3] Gates met the 10,000-Hour Rule when he gained access to a high school computer in 1968 at the age of 13, and spent 10,000 hours programming on it.[3]

http://en.wikipedia.org/wiki/Outliers_(book)

"but there is no instruction manual"
http://jobmob.co.il/blog/funny-ikea-job-interview-cartoon/

Ph.D. program milestones

RESEARCH

=4-5 years

COURSES

(GCCs)

1   2   3   4

RFE
(Y2-Fall)
="prelim"

Candidacy
(RFE + 18 credits
at UM)

Dissertation
proposal exam
(w/committee,
timing flexible)
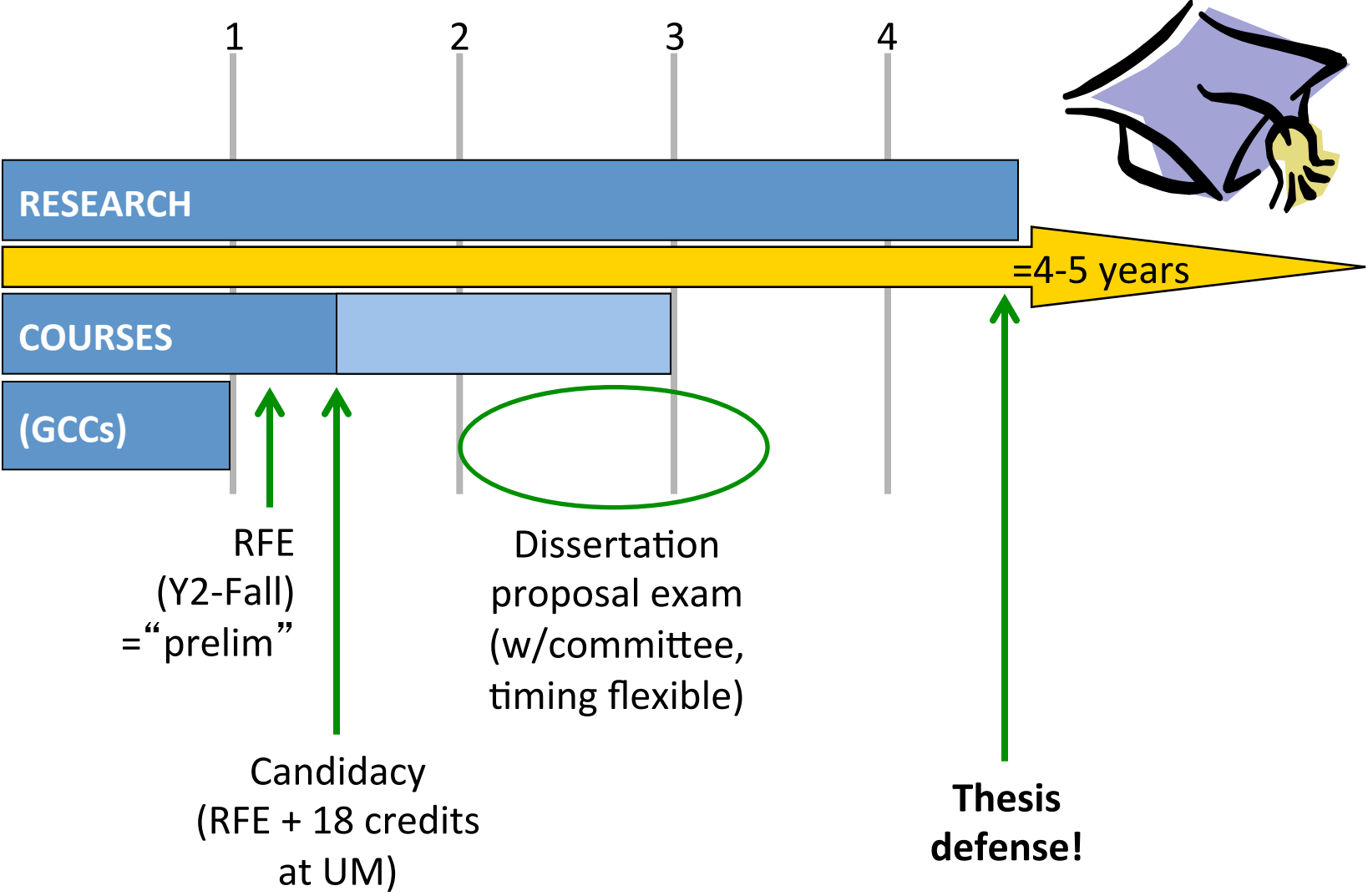
**Thesis
defense!**

The RFE

- <u>Research</u>
- <u>Fundamentals</u>
- <u>Exam</u>

- "15 minute presentation + 30 minute Q+A"
  → a 45 minute discussion

- Abstract submitted ahead of time
- Used to select the examiners …they may read it before the exam

RFE – evaluation criteria (as of F10)

- **Synthesis of Course Material in Research Problem Context:** The student is able to connect his/her research problem to undergrad material from engineering, math, physics, chemistry, biology, etc.

- **Input to Research Project:** Student has read and understands the state of the art, has identified a need for original knowledge development, and understands what technical subjects need to be learned.

- **Research Conduct and Methodology:** Student has presented a valid research objective, can apply a rigorous research process, and can draw appropriate inferences from analysis or data collection. The student shows indications of appropriate problem solving and technical skills applicable to the research problem presented. The work must clearly be that of the student and not the work of others from the research group.
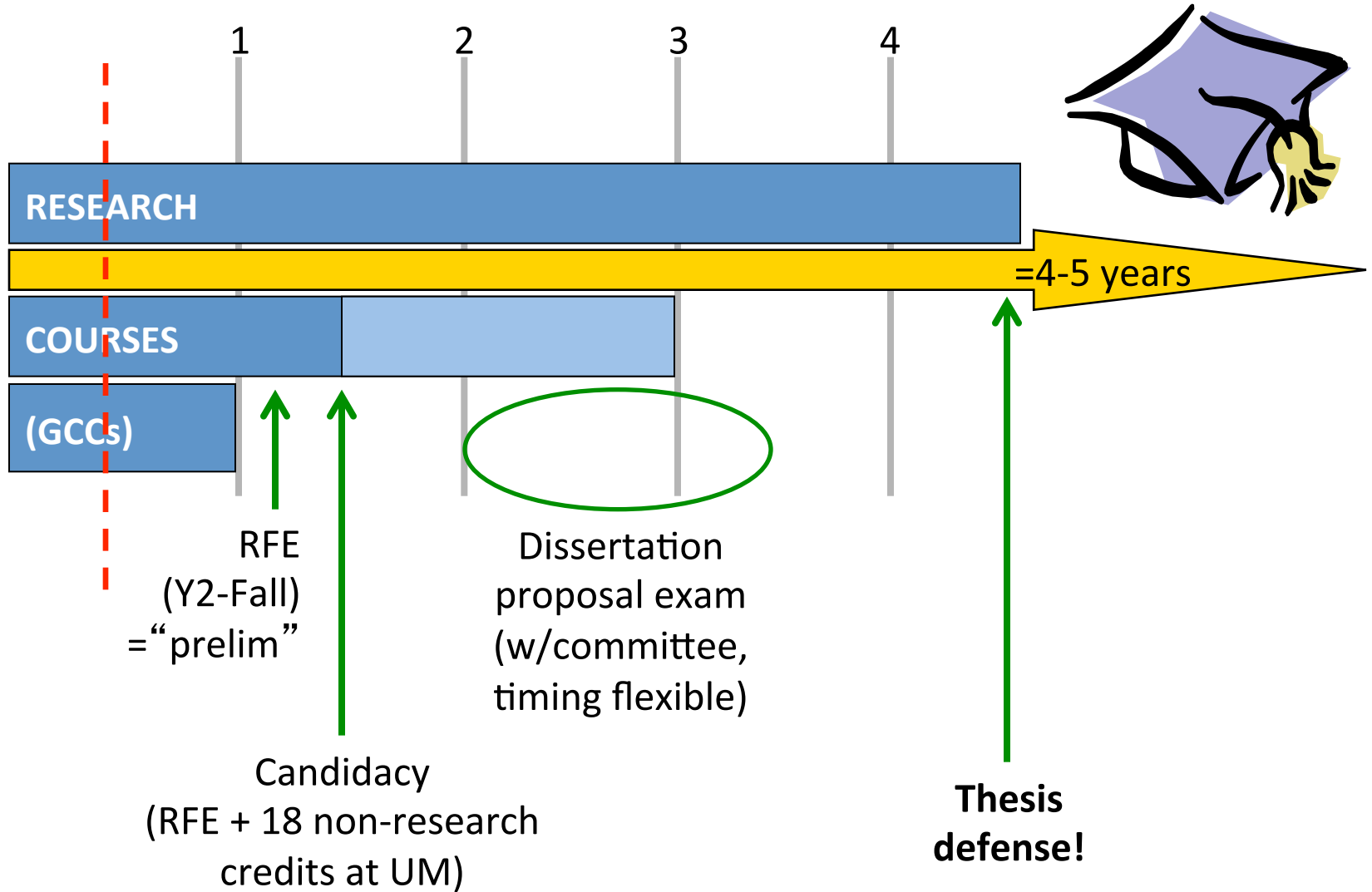
RFE – evaluation criteria (as of F10)

- **Research Outcomes:** The student is able to draw conclusions from the work where appropriate; the student understands the limitations of what s/he has done so far; and the student provides evidence of being able to think about the next steps that should be taken (independent of where student is in the research process).

- **Communication:** Student is an effective oral and written communicator of research concepts.

→ **These criteria are weighted equally, and scored by each examiner.**

ME Ph.D. program milestones

RESEARCH

COURSES

(GCCs)

1   2   3   4

=4-5 years

RFE
(Y2-Fall)
="prelim"

Dissertation
proposal exam
(w/committee,
timing flexible)

Candidacy
(RFE + 18 non-research
credits at UM)

**Thesis
defense!**

Themes

- Defining research and identifying your interests
- Searching literature and choosing a research topic
- Planning and doing research
- Communicating research (written, visual, and verbal)
- Beyond the Ph.D. program

How will we learn?

→ Readings and assignments (step-by-step)

→ Open dialogue and peer review

→ Practicing and refining our thought process

Everyone has different interests, background, perspective
→ your **individual** Ph.D. program

Schedule (subject to change)

#	Date	Theme	Pre-class task (Thurs 2pm)	Assignment (Fri 2pm)
0	Jan/6	Course overview; recap of ME RFE/candidacy process		
1	Jan/13	Defining "research"	Research words	
2	Jan/20	Searching and analyzing the literature	Research theme	
3	Jan/27	Creativity and impact; choosing a research topic		
4	Feb/3	Planning and time management		Literature search
5	Feb/10	Advisor-student relations; mentorship and collaboration	Discussion topics	
6	Feb/17	Responsible conduct of research		
	Feb/24	No class		Background report
	Mar/2	No class (spring break)		
7	Mar/9	Formulating and writing a proposal	Proposal exercise	
8	Mar/16	Evaluating proposals	Proposal aims	
9	Mar/23	Graphics and visual aids		Proposal
10	Mar/30	Giving and evaluating presentations	Proposal peer-review	
11	Apr/6	Research administration and commercialization	Discussion topics	
12	Apr/13	Student presentations (extended session)		Presentation

Assignments

In-class participation[1]	10
Pre-class tasks and peer review[2]	10
Literature search	5
Background report	30
Research proposal	30
Presentation	15
Total	100

[1] Will be graded on a 1-10 scale overall for the semester. Everyone can get 10/10.

[2] Will be graded 0/50/100% in each instance. 0 = nothing or late; 50 = partially complete or did not follow instructions; 100 = complete.

What is research?

← → C ⌂ ◎ wordnetweb.princeton.edu/perl/webwn?s=research ☆ ⚲

DB   GR   GF   GD   todo   GM   miles   sam   OL   tvl   weath   sc   NESN   eb   bdd   ESPN   wacc   »   Other Bookmarks

WordNet Search - 3.0 - WordNet home page - Glossary - Help

Word to search for: [research] (Search WordNet)
Display Options: (Select option to change) ▼ (Change)
Key: "S:" = Show Synset (semantic) relations, "W:" = Show Word (lexical) relations

Noun

- S: (n) **research** (systematic investigation to establish facts)
- S: (n) inquiry, enquiry, **research** (a search for knowledge) "*their pottery deserves more research than it has received*"

Verb

- S: (v) **research** (attempt to find out in a systematically and scientific manner) "*The student researched the history of that word*"
- S: (v) **research**, search, explore (inquire into) "*the students had to research the history of the Second World War for their history project*"; "*He searched for information on his relatives on the web*"; "*Scientists are exploring the nature of consciousness*"
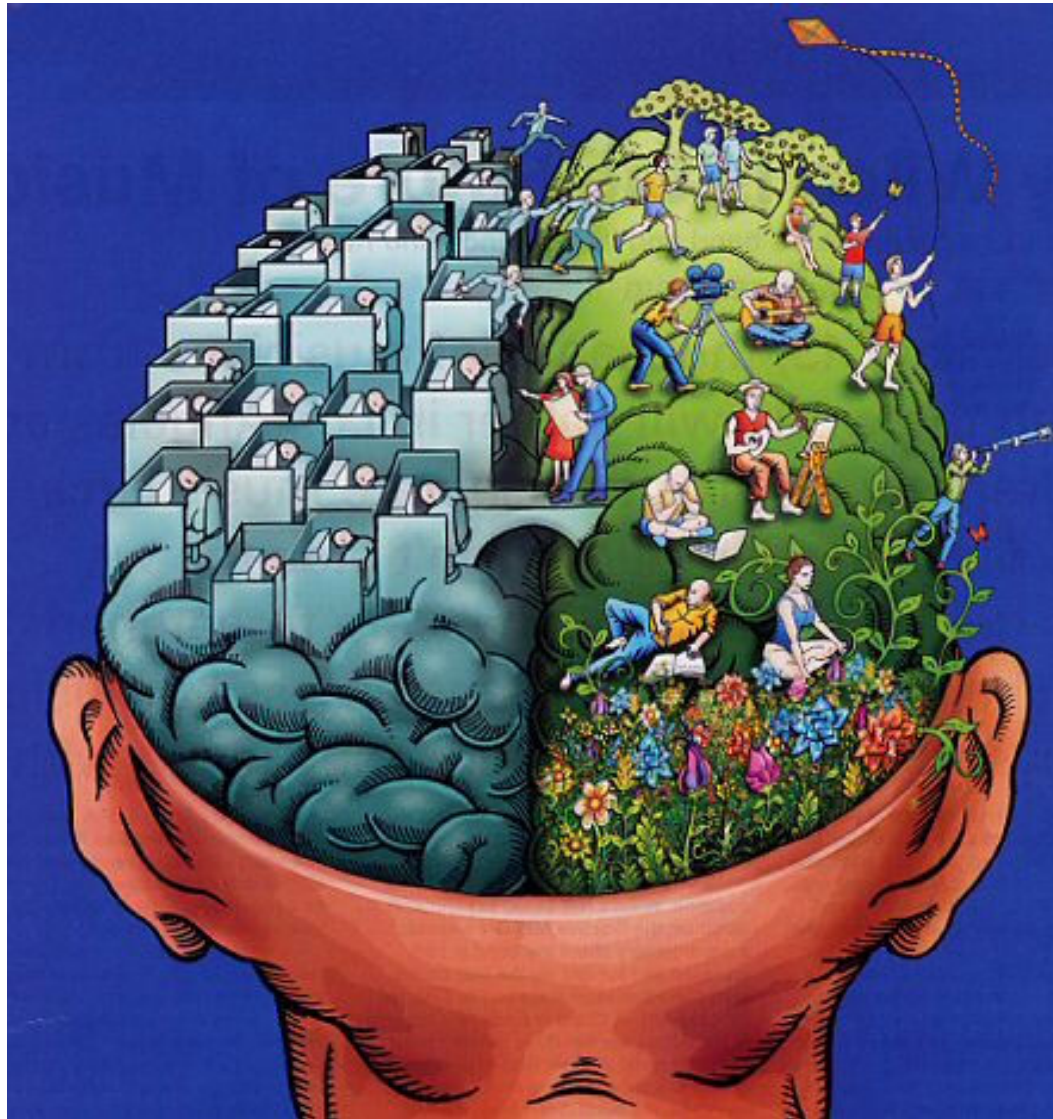
WordNet home page

"Research is fundamentally a state of mind involving continual reexamination of doctrines and axioms upon which current thought and action are based. It is, therefore, critical of existing practices"
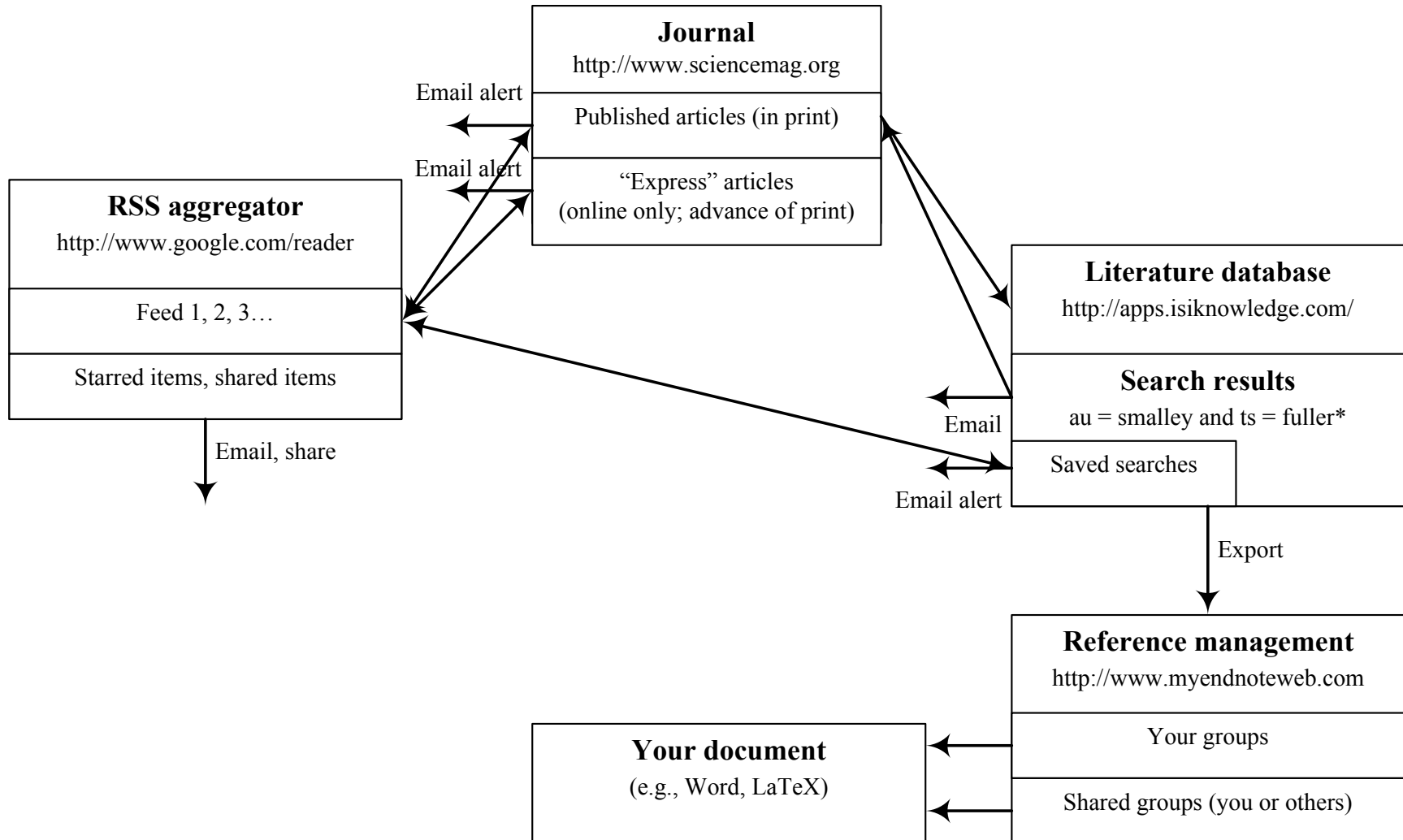
-Theobald Smith (1859-1934)

[considered to be America's first world-renowned medical research scientist]

How do you think and learn?

John's approach to Digital Literature Management (DLM)
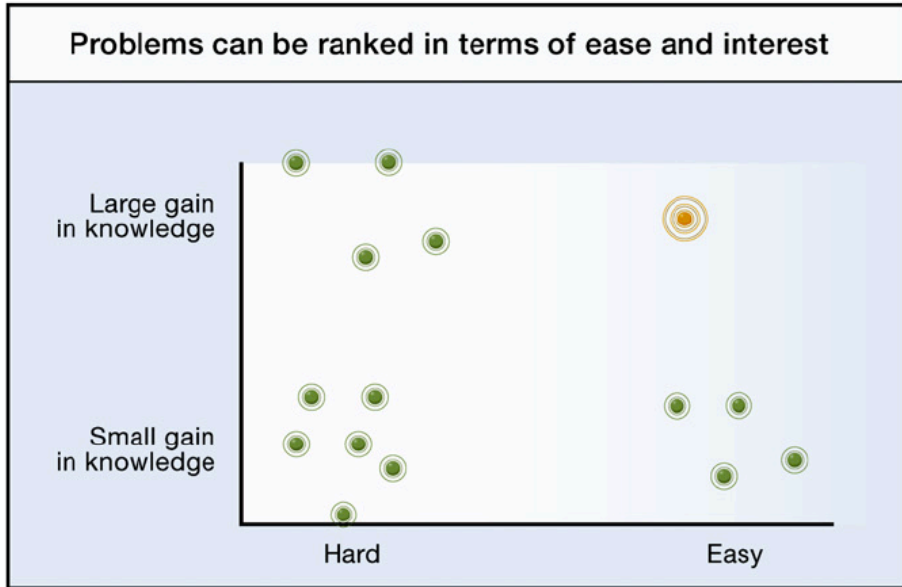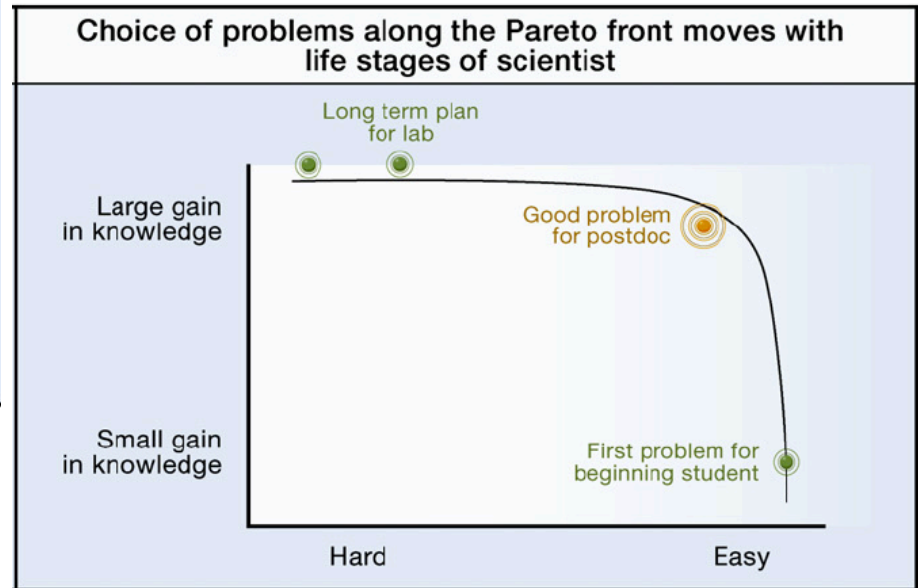
Choosing a problem

Figure 1. The Feasibility-Interest Diagram for Choosing a Project
Two axes for choosing scientific problems: feasibility and interest.
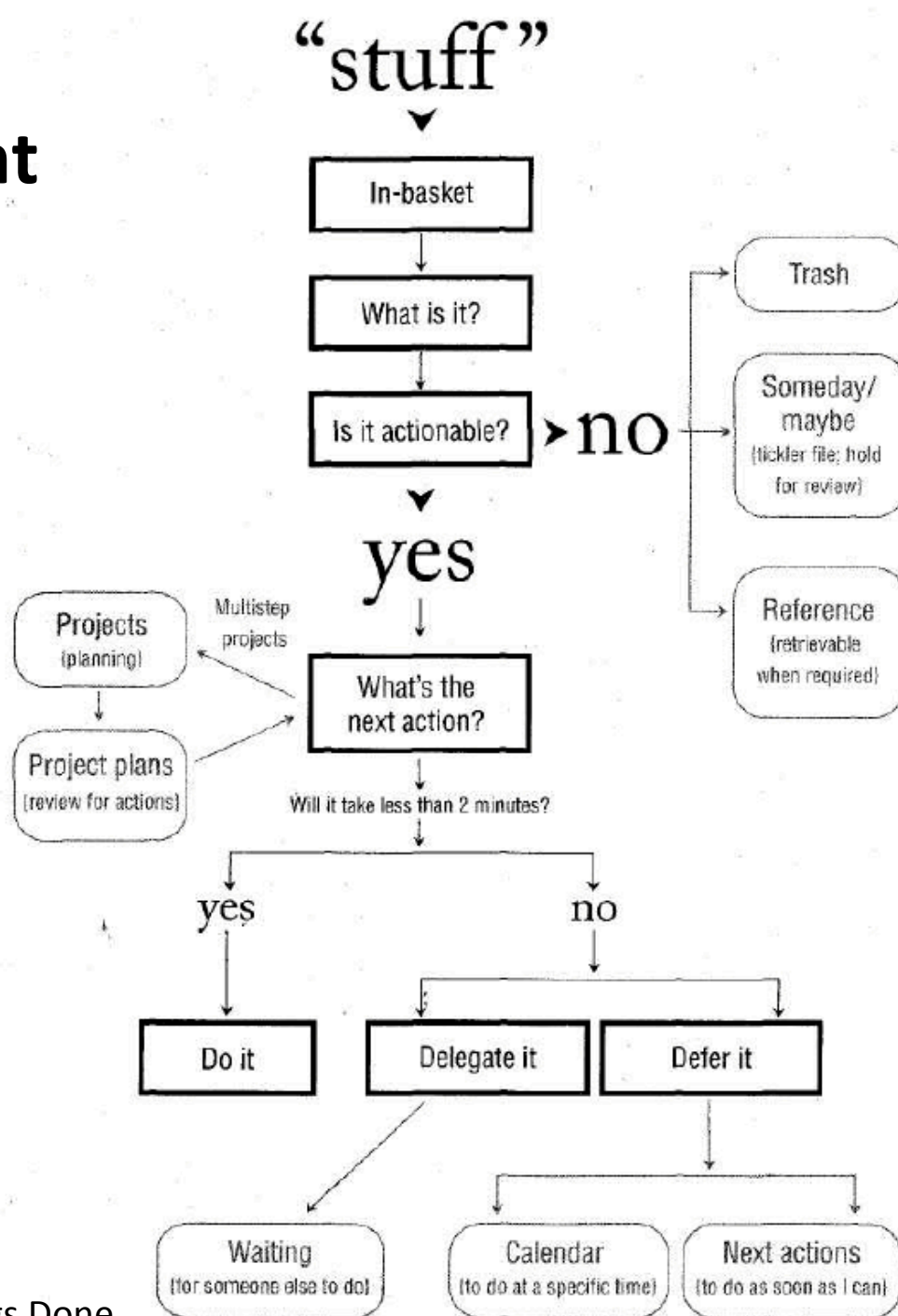
"Never, ever, think outside the box."
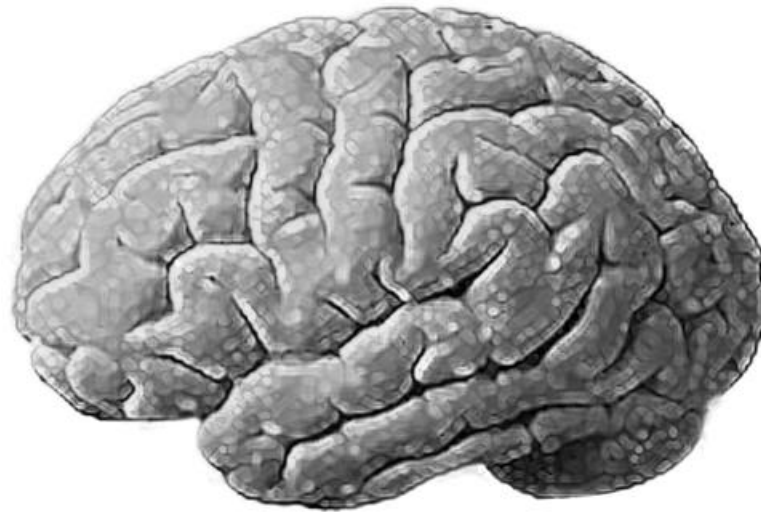
© THE NEW YORKER

Most people can learn to be far more creative than they are. Our school system emphasizes single correct answers and provides few opportunities for exploratory learning, problem solving, or innovation. Suddenly, when one becomes a graduate student, however, it is expected that one is automatically an independent thinker and a creative problem solver.

Loehle, "A guide to increased creativity in research – inspiration or perspiration?"

Research output vs. time?

Research freedom vs. time?

BARKING UP THE WRONG TREE...

Time management

"stuff"

In-basket → What is it? → Is it actionable?

Is it actionable? → no → Trash / Someday/maybe (tickler file; hold for review) / Reference (retrievable when required)

Is it actionable? → yes → What's the next action?

Projects (planning) → Project plans (review for actions) → Multistep projects → What's the next action?

What's the next action? → Will it take less than 2 minutes?

yes → Do it

no → Delegate it / Defer it

Delegate it → Waiting (for someone else to do)

Defer it → Calendar (to do at a specific time) / Next actions (to do as soon as I can)

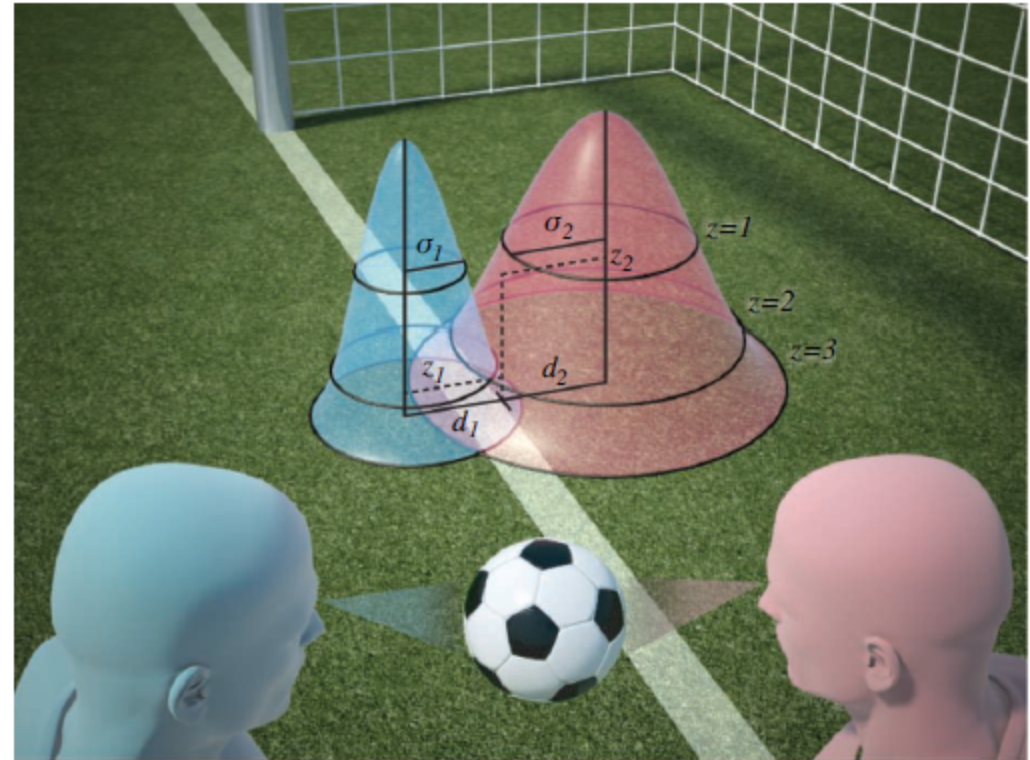David Allen, Getting Things Done

"It's a waste of time and energy to keep thinking about something that you make no progress on"

-David Allen

Advisor-student relations, teamwork

Joint decisions. Noisy estimates of the landing position of the ball for Referee 1 (blue) and Referee 2 (red). See the text for a description on how referees might make the best possible decision on where the ball landed.

"Optimally interacting minds" by Behrami et al., *Science* 329, 2010; perspective by Ernst.

Responsible conduct of research?

✓ **HONESTY** — conveying information truthfully and honoring commitments,

✓ **ACCURACY** — reporting findings precisely and taking care to avoid errors,

✓ **EFFICIENCY** — using resources wisely and avoiding waste, and

✓ **OBJECTIVITY** — letting the facts speak for themselves and avoiding improper bias.

ORI
Introduction to the Responsible Conduct of Research
Nicholas H. Steneck
illustrations by David Zinn
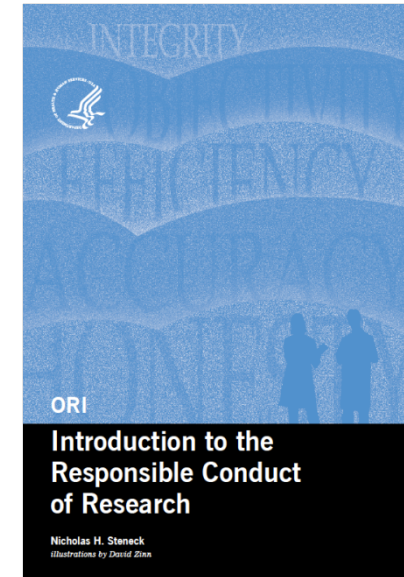
Structuring a proposal (just like choosing a research problem)

- <u>Feasibility</u>: "whether a problem is hard or easy, in units such as the expected time to complete a project". [Alon]

- <u>Importance</u>: how important is the topic within the research community and beyond?

- <u>Interest</u>: both internal and external…

- <u>Competence</u>: why are you qualified? Do you have an advantage (secret weapon)?
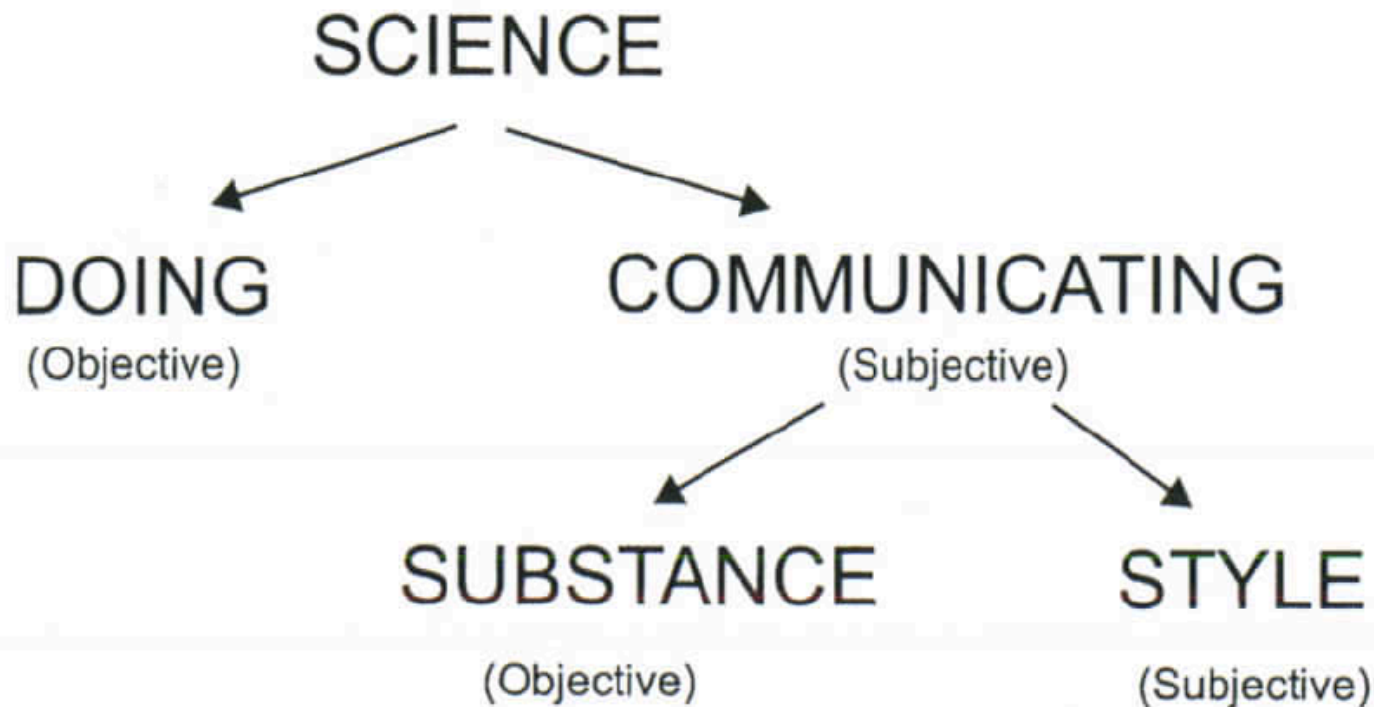
Dividing the big idea: objectives/aims
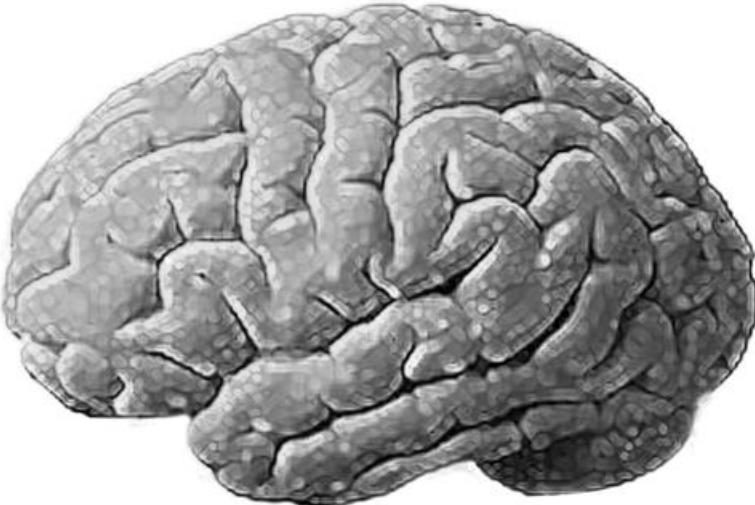
Presentations: communicating what you did
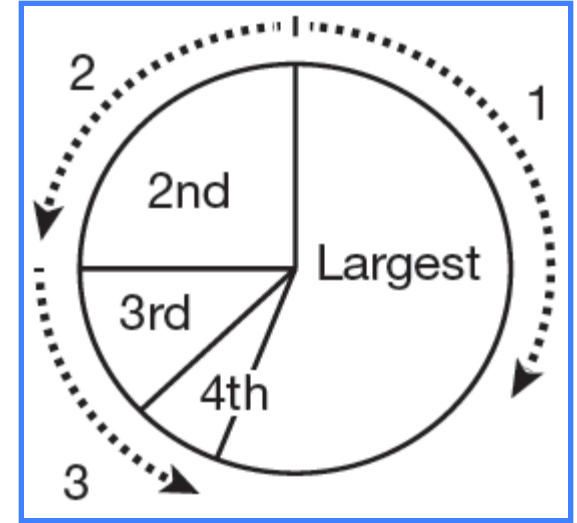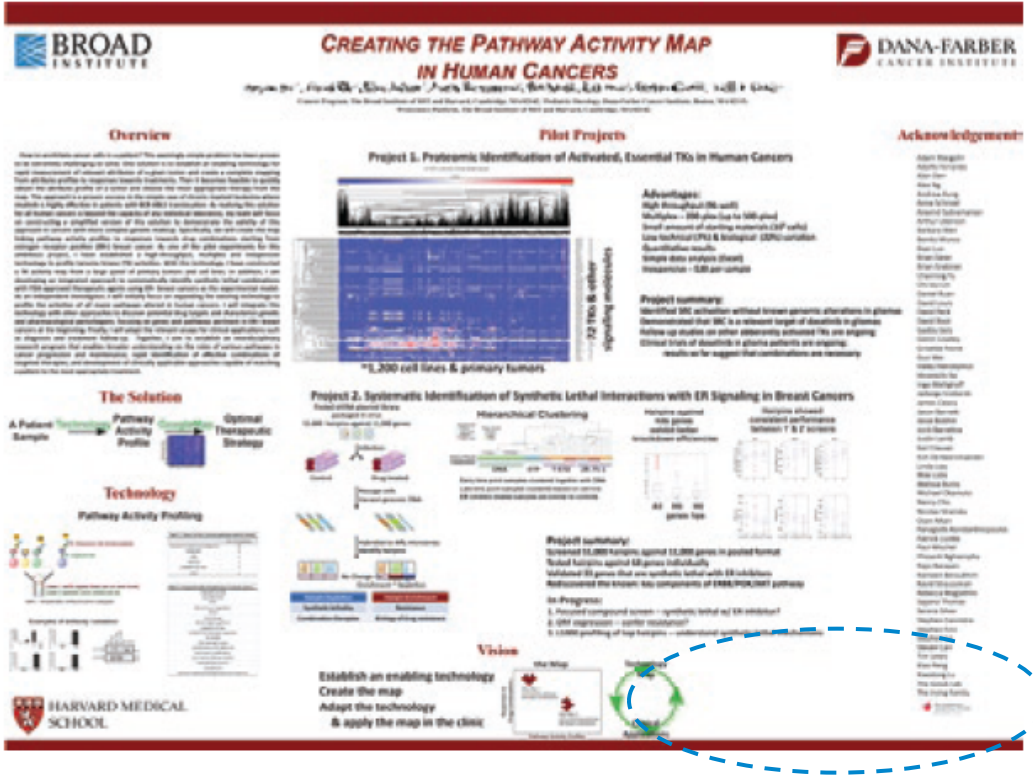
- Planning the presentation
- Building the content (slides)
- Preparing the narrative and practicing
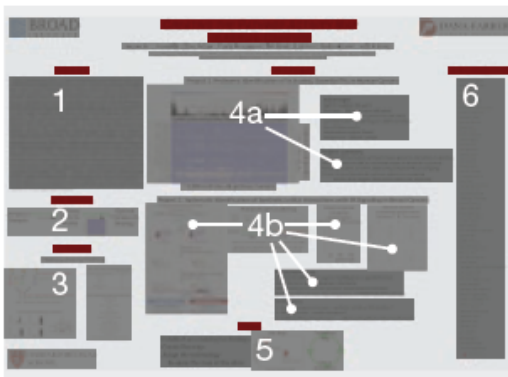- Delivering the presentation

SCIENCE

DOING
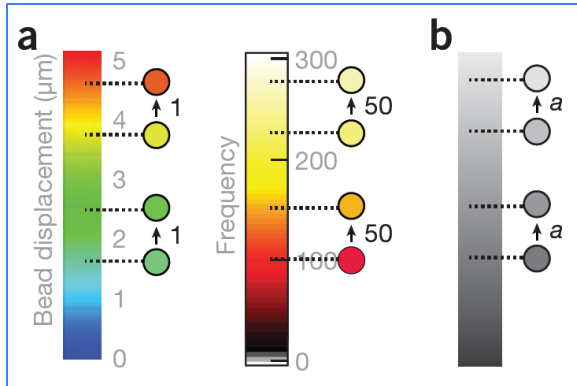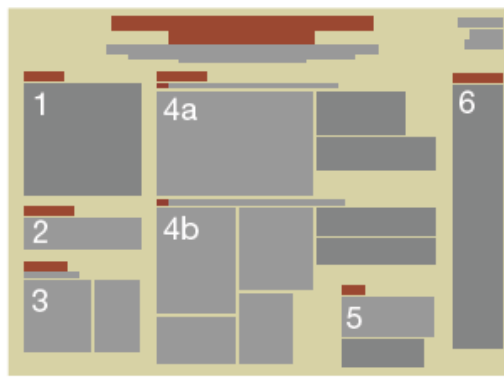(Objective)

COMMUNICATING
(Subjective)

SUBSTANCE
(Objective)

STYLE
(Subjective)

Visuals

Research administration and commercialization

Figure 1: Research Expenditures by Major Sponsor Group, FY2001-2010

$1.14B
+12.1%

- U-M (internal) sponsors
- Non-federal sponsors
- Federal sponsor
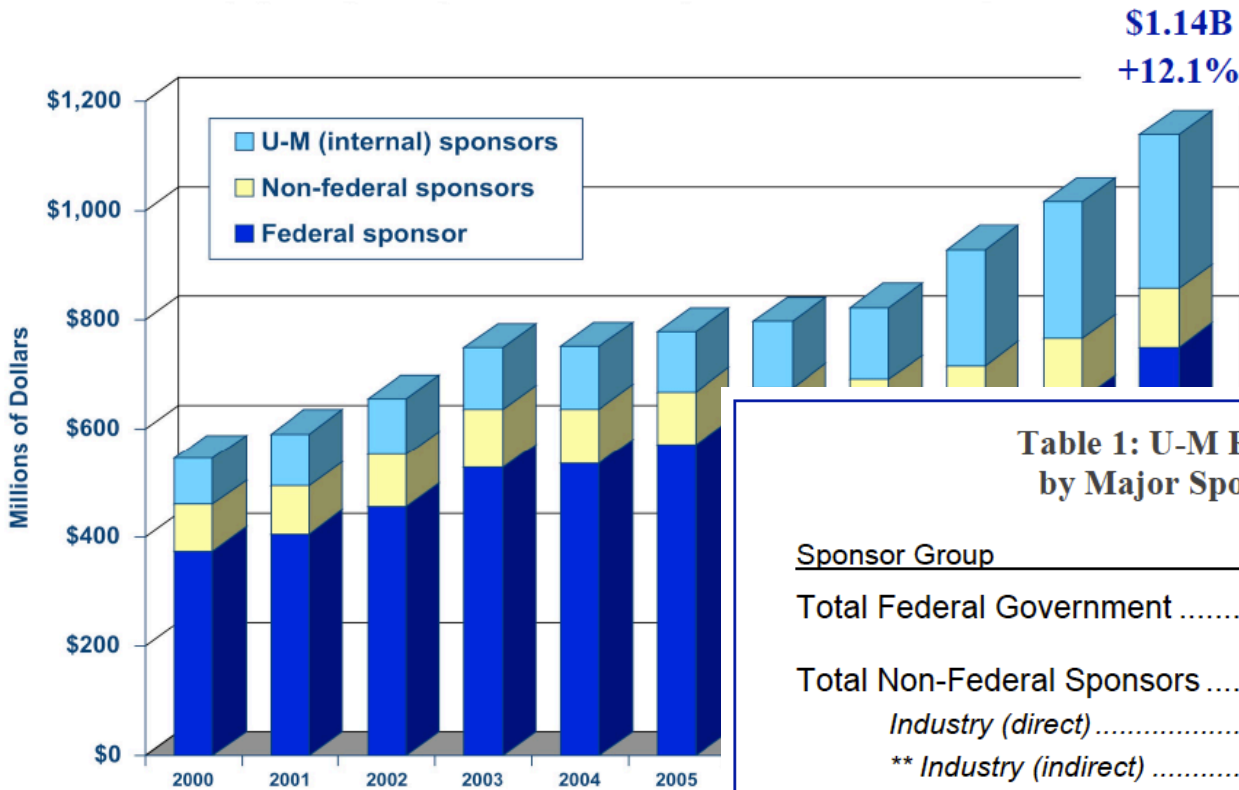
Table 1: U-M Research Expenditures by Major Sponsor Group, FY2010

Sponsor Group	Expenditures	% of total
Total Federal Government	$750,937,613	65.9%
Total Non-Federal Sponsors	$106,762,901	9.4%
Industry (direct)	$39,269,613	3.4%
** Industry (indirect)	$18,321,297	
Foundations	$24,881,157	2.2%
State of Michigan/Counties/Cities	$3,792,924	0.3%
Total U-M Funds	$281,793,811	24.7%
Total Research Expenditures	$1,139,493,986	

**subcontracts from industry included under federal government as the prime sponsor; see also Table 3.

ME department only

ANNUAL RESEARCH EXPENDITURES
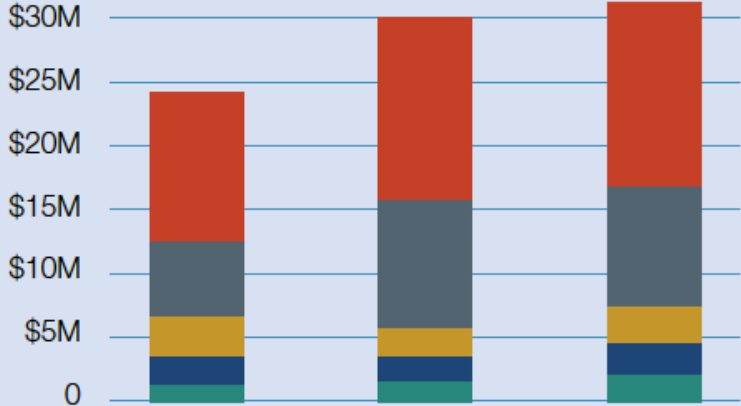
	07–08	08–09	09–10
NIH	1,232,517	1,403,643	1,996,237
DoE	1,885,113	1,773,858	2,390,860
NSF	3,099,414	2,460,177	2,701,330
DoD	6,030,570	10,195,017	10,992,316
All Other	12,076,860	14,608,221	13,792,756
Total	$24,324,474	$30,440,916	$31,873,499

	FA08	FA09	FA10
Assistant	10	11	12
Associate	11	12	12
Professor	36	35	36
Total Faculty	57	58	60
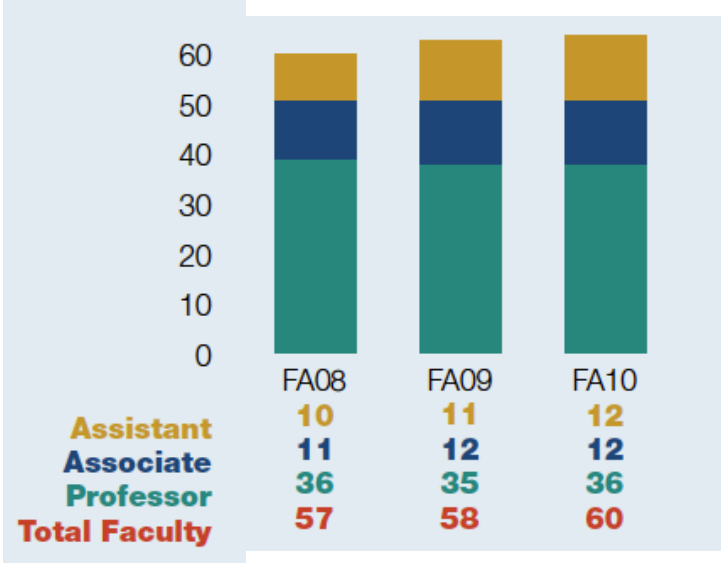
Figure O-24
Value added of knowledge-intensive and high-technology industries as share of region's/country's GDP: 1995–2007
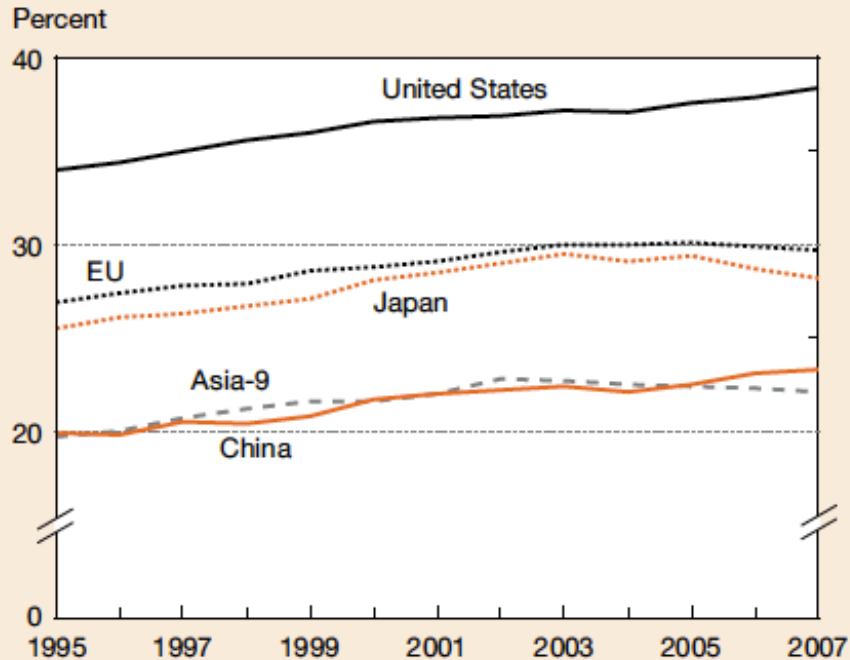
EU = European Union; GDP = gross domestic product

NOTE: Knowledge intensive services and high technology manufacturing industries as defined by Organisation for Economic Co-operation and Development. See glossary for countries included in Asia-9. China includes Hong Kong. EU excludes Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Malta, and Slovenia.

SOURCE: IHS Global Insight, World Industry Service database, special tabulations.

Science and Engineering Indicators 2010

What is the goal of a Ph.D. program?

What do you want to gain from your Ph.D.?

What is success?

"Success is peace of mind which is a direct result of self-satisfaction in knowing you made the effort to become the best of which you are capable."

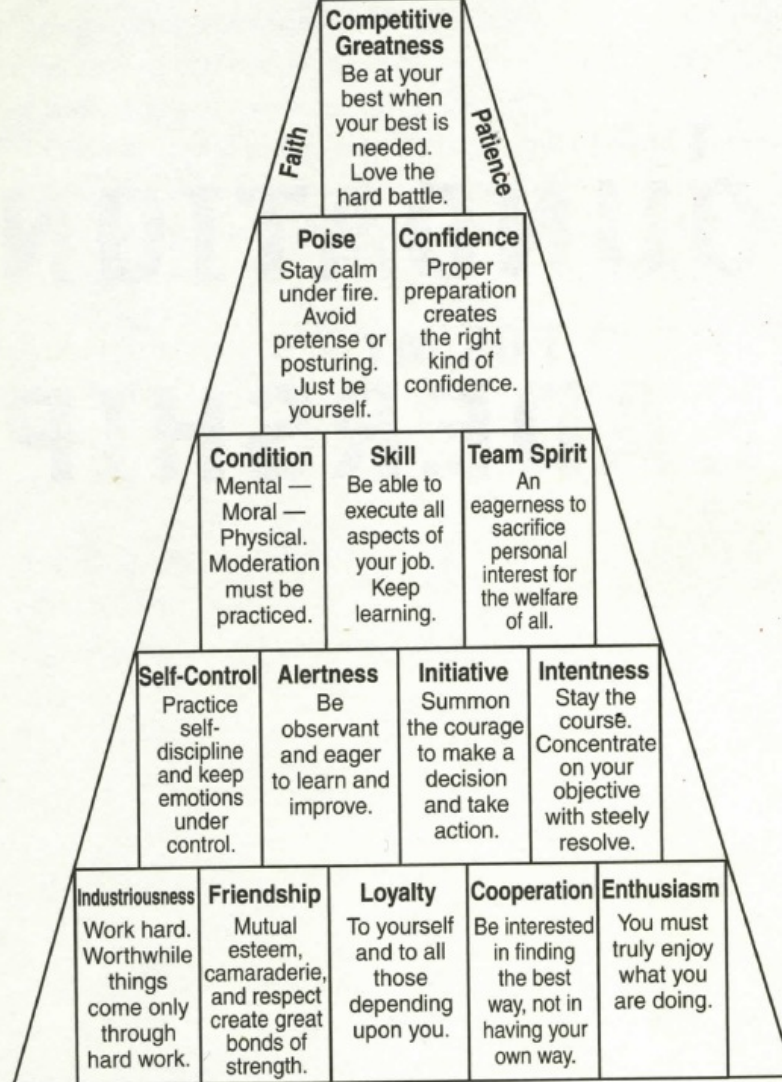"Focus on running the race rather than winning it … Don't lose sleep worrying about the competition. Let the competition lose sleep worrying about you."

-John Wooden (1910-2010)

[hall of fame basketball player and coach, 7 consecutive national championships at UCLA]
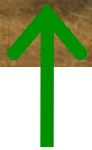
SUCCESS

Competitive Greatness
Be at your best when your best is needed. Love the hard battle.

Faith

Patience

Poise
Stay calm under fire. Avoid pretense or posturing. Just be yourself.

Confidence
Proper preparation creates the right kind of confidence.

Condition
Mental — Moral — Physical. Moderation must be practiced.

Skill
Be able to execute all aspects of your job. Keep learning.

Team Spirit
An eagerness to sacrifice personal interest for the welfare of all.

Self-Control
Practice self-discipline and keep emotions under control.

Alertness
Be observant and eager to learn and improve.

Initiative
Summon the courage to make a decision and take action.

Intentness
Stay the course. Concentrate on your objective with steely resolve.

Industriousness
Work hard. Worthwhile things come only through hard work.

Friendship
Mutual esteem, camaraderie, and respect create great bonds of strength.

Loyalty
To yourself and to all those depending upon you.

Cooperation
Be interested in finding the best way, not in having your own way.

Enthusiasm
You must truly enjoy what you are doing.

John Wooden

A.J. Hart | 37

Focus!

observers

you

goal

"It is not so much the talents we possess so much as the use we make of them that counts in the progress of the world."

-Brailsford Robinson

[?]

Homework

- Readings for <u>lecture 1</u> (on ctools)

  Choose 2 of 3

  - Beveridge, "Scientists", excerpt from <u>The Art of Scientific Investigation</u>
  - Desjardins, "How to Succeed in Graduate School: A Guide for Students and Advisors"
  - Hamming, "You and Your Research"

- Research words, see next slide – **due 2pm Thu Jan/12**

- Send comments on course content to <u>ajohnh@umich.edu</u>

Research words assignment

Due   Jan 12, 2012 2:00 pm
Status   Not Started
Grade Scale: Checkmark

Assignment Instructions

Come up with 5 words representing each of the themes below.

a. The practice of doing good research, e.g., "doing good research is…"

b. Good research when you evaluate it, e.g., "his/her research is good because it is…"

c. Attributes of a good researcher, e.g., "you're/i'm a good researcher because…"

Put your words in the attached template file (researchwords.xls)

Add your last name to the filename:

lastname-researchwords.xls (example: hart-researchwords.xlsx)

Additional resources for assignment

🖼️ researchwords.xls **(24 KB)**

Submission

This assignment allows submissions by attaching documents only. Use the Add Attachments button below to attach 1 or more documents.

Attachments

No attachments yet

(Add Attachments)