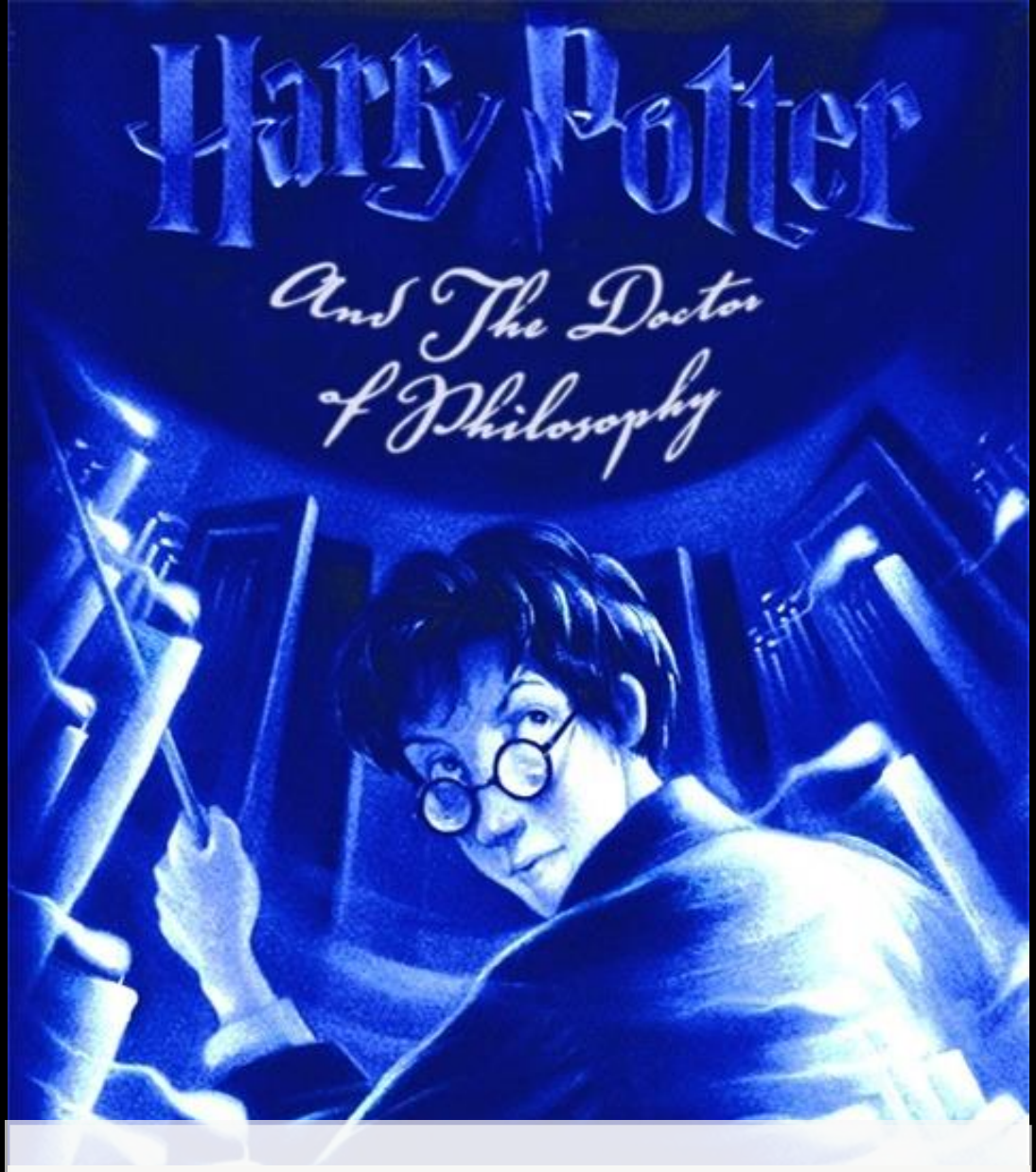


How to succeed in grad school

M. Scott Shell, UCSB Chem Eng

Why are you here?

- to learn more
- to get research experience
- to get a better job / an R&D job / an academic job
- to make more money
- you didn't know what else to do
- self / peer / parental pressure to "succeed"

What's the point of a PhD education?

A PhD means you are capable of *leading* an independent research investigation to create *new* knowledge and to *communicate* it to the scientific world.

How to succeed, the big picture

1. Don’t ask “what.” Ask “how.”
2. Work hard and then harder
3. Work smart

How to succeed, the big picture

1. **Don’t ask “what.” Ask “how.”**
2. Work hard and then harder
3. Work smart

undergraduate mode

What do I need to do?

answering questions
structured coursework
teacher guidance
“me”-focused

research mode

How can the problem be solved?

posing questions
self-guided learning
highly independent
project-focused

A simple reaction mechanism

$$\frac{d[\mathrm{UM}]}{dt} = -k_1[\mathrm{UM}]$$

$$\frac{d[\mathrm{RM}]}{dt} = k_1[\mathrm{UM}]$$

$$\frac{d[\mathrm{discovery}]}{dt} = k_2[\mathrm{RM}]$$

$$\frac{d[\mathrm{Ph.D.}]}{dt} = k_3[\mathrm{Discovery}][\mathrm{RM}]$$

undergrad mode [UM] $\xrightarrow{k_1}$ research mode [RM]

research mode [RM] $\xrightarrow{k_2}$ discovery, new knowledge

discovery + RM $\xrightarrow{k_3}$ Ph.D.

A simple reaction mechanism

$$\frac{d[\mathrm{UM}]}{dt} = -k_1[\mathrm{UM}]$$

$$\frac{d[\mathrm{RM}]}{dt} = k_1[\mathrm{UM}]$$

$$\frac{d[\mathrm{discovery}]}{dt} = k_2[\mathrm{RM}]$$

$$\frac{d[\mathrm{Ph.D.}]}{dt} = k_3[\mathrm{Discovery}][\mathrm{RM}]$$

$$\frac{d[\mathrm{CM}]}{dt} = k_4[\mathrm{slacking}] - k_5[\mathrm{fear}]$$

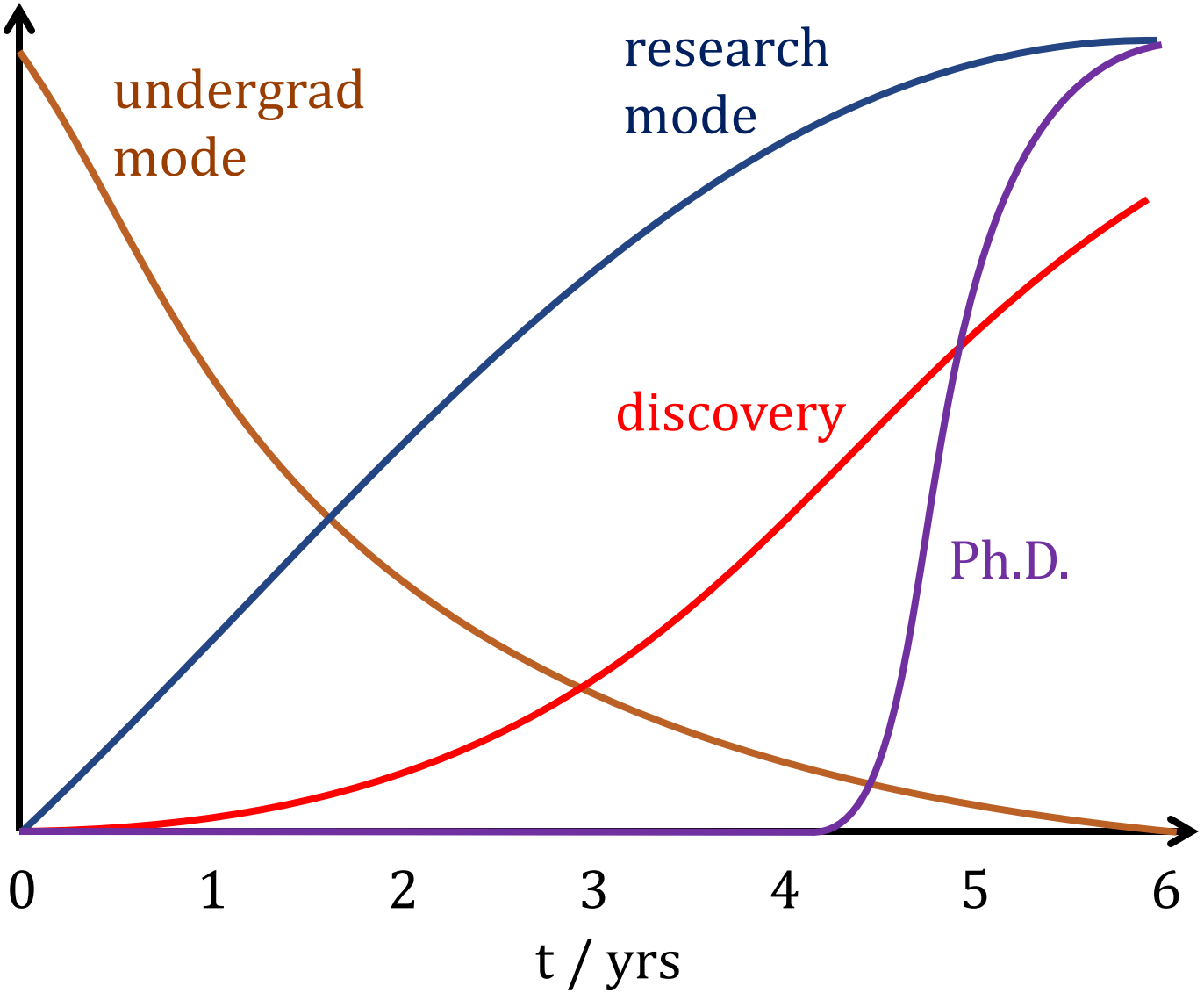
undergrad mode [UM] $\xrightarrow{k_1}$ research mode [RM]

research mode [RM] $\xrightarrow{k_2}$ discovery, new knowledge

discovery + RM $\xrightarrow{k_3}$ Ph.D.

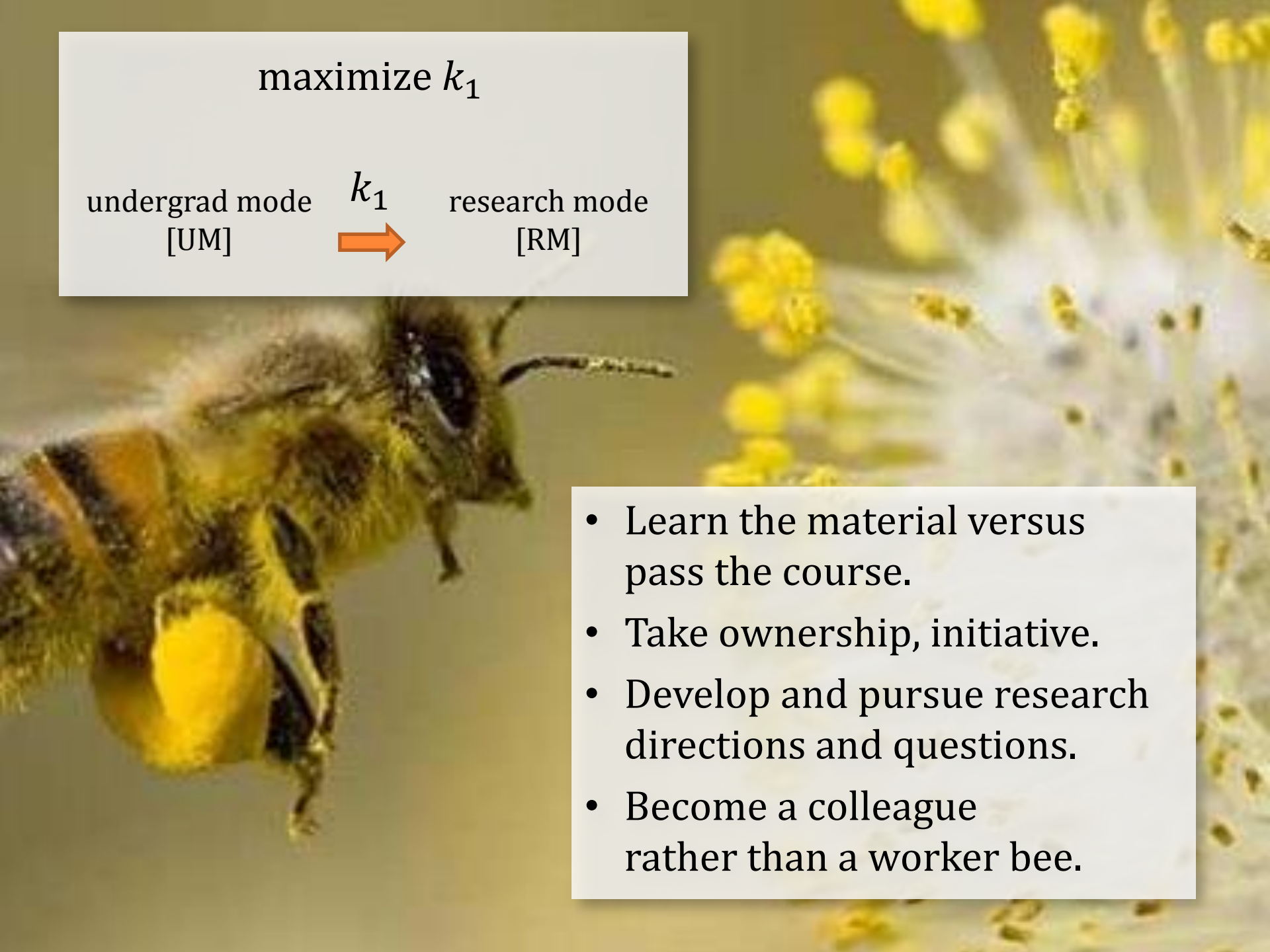
any mode + slack $\xrightarrow{k_4}$ coasting mode

coasting mode + fear $\xrightarrow{k_5}$ back on track


undergrad
mode
research
mode
discovery
Ph.D.
0
1
2
3
4
5
6
t / yrs

maximize k_1

undergrad mode [UM] $\xrightarrow{k_1}$ research mode [RM]



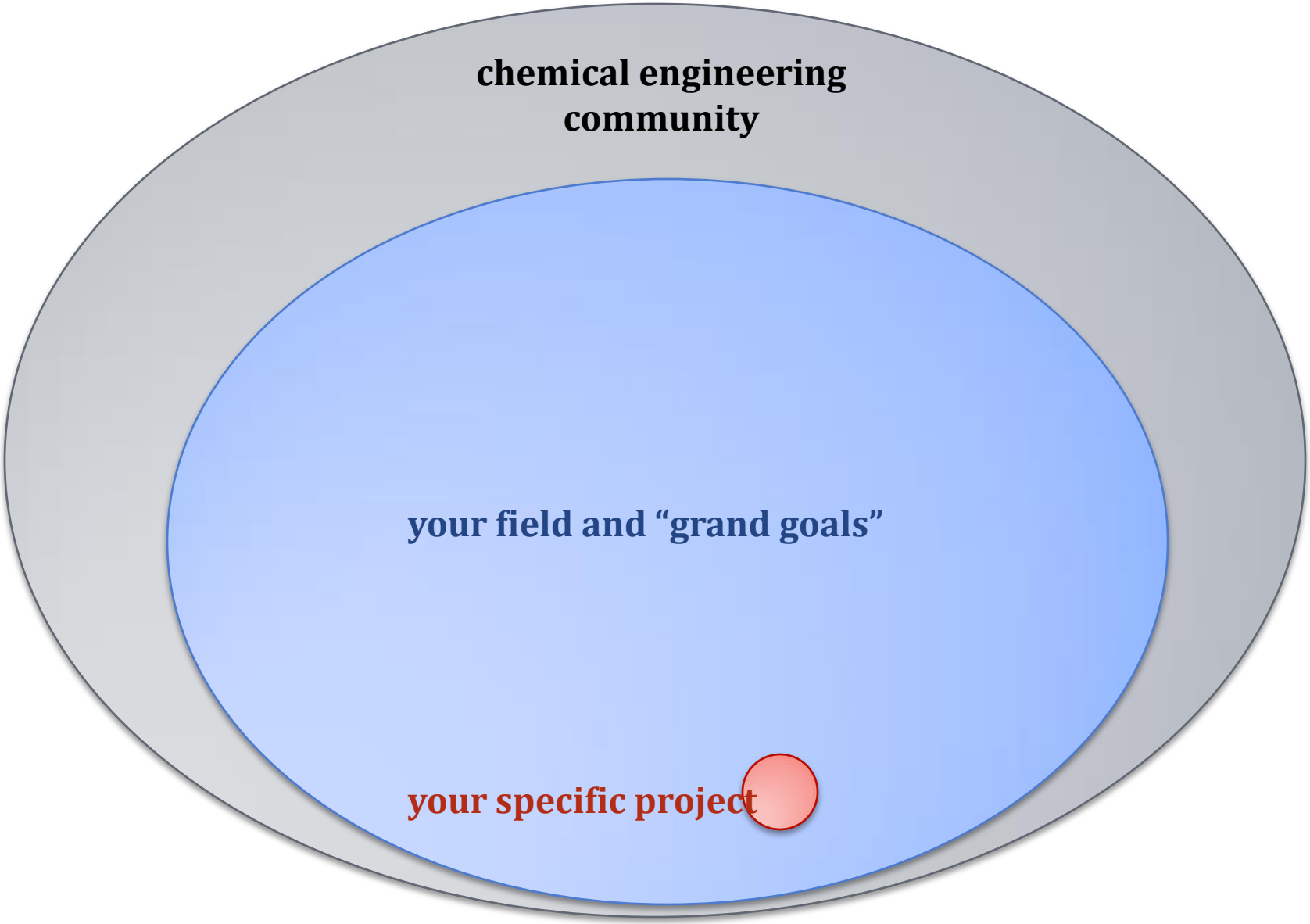
- Learn the material versus pass the course.
- Take ownership, initiative.
- Develop and pursue research directions and questions.
- Become a colleague rather than a worker bee.

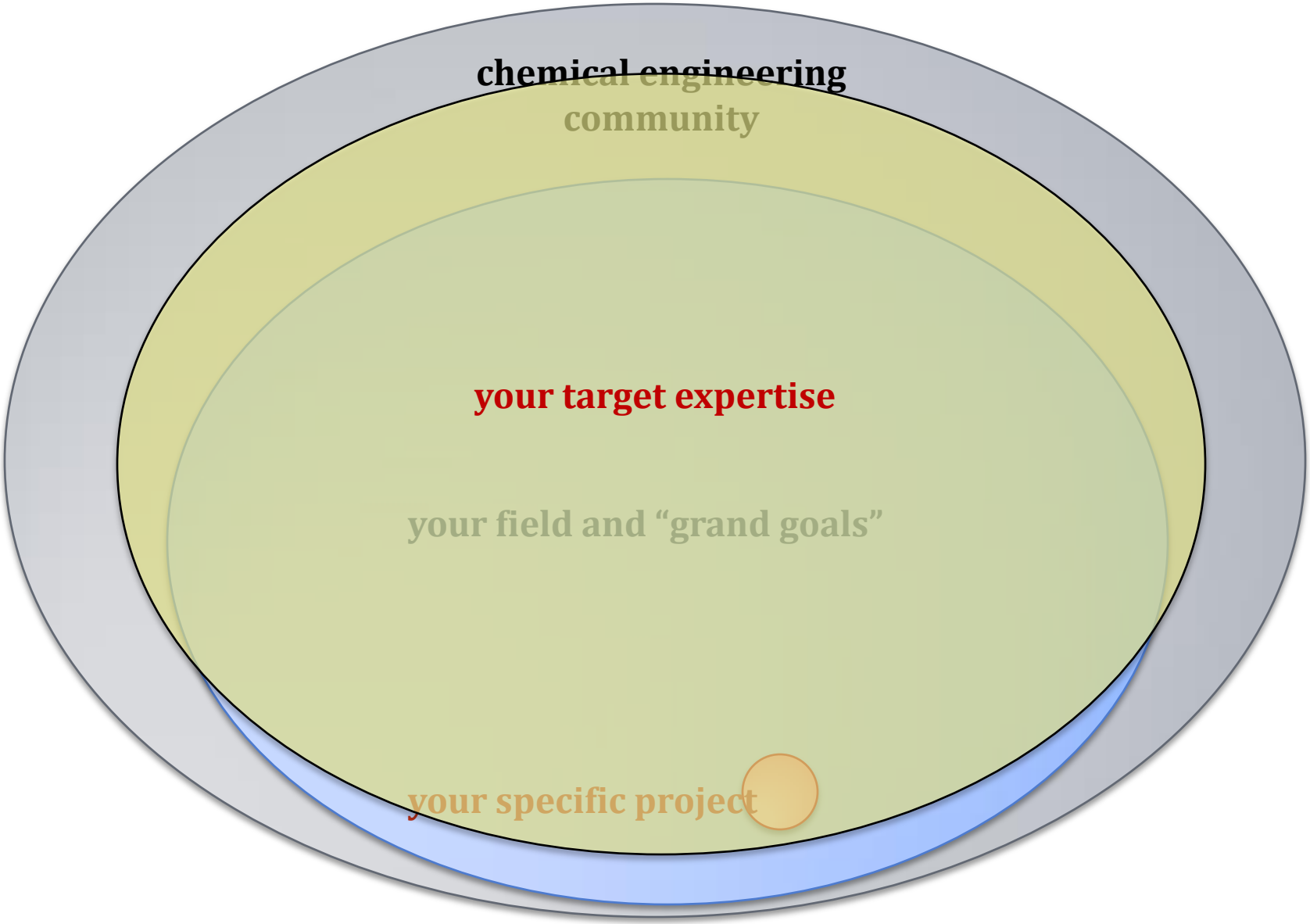
grad student advisor

grad student advisor

How to succeed, the big picture

1. Don’t ask “what.” Ask “how.”
2. **Work hard and then harder**
3. Work smart


chemical engineering community
your field and "grand goals"
your specific project


chemical engineering
community
your target expertise
your field and “grand goals”
your specific project

- Why not learn it?
- Why not figure it out?
- Yes you can.

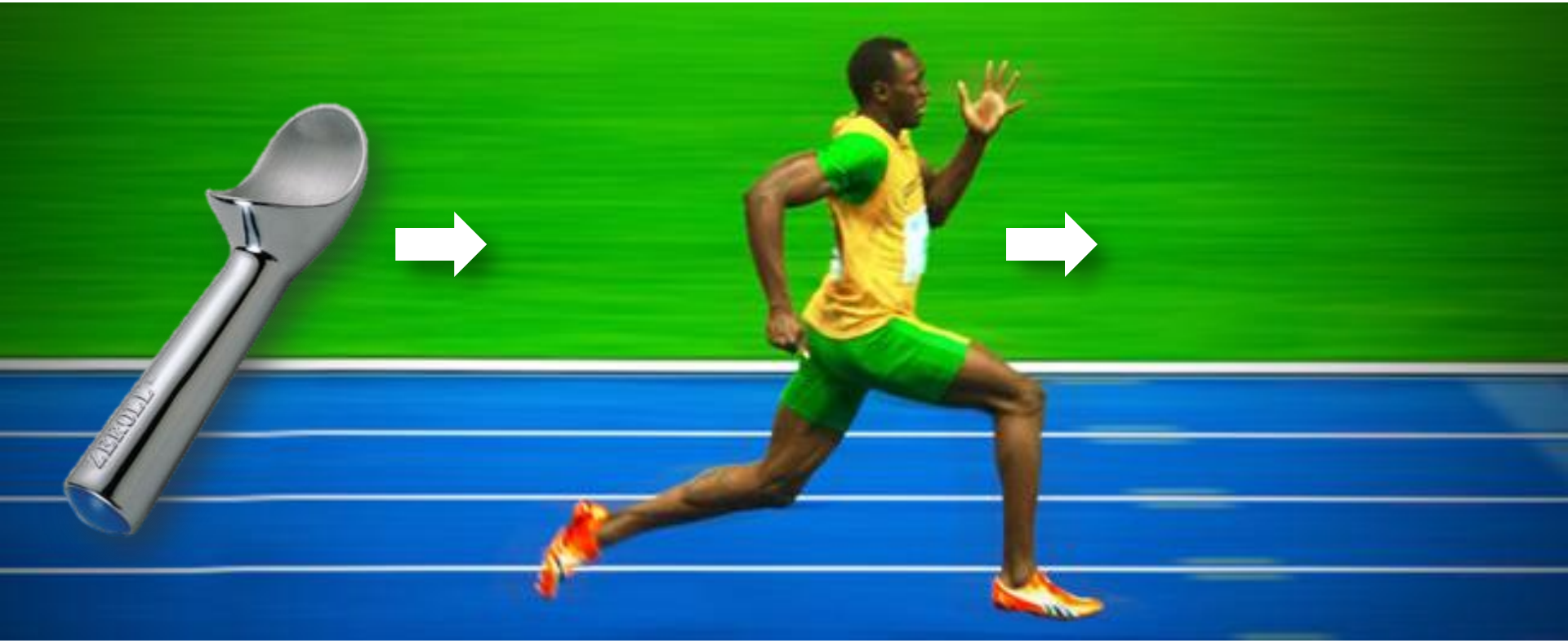
What does it take to become an expert?

$$\frac{10{,}000 \text{ hours}}{4 \text{ years}} \approx 50 \frac{\text{hrs}}{\text{wk}}$$

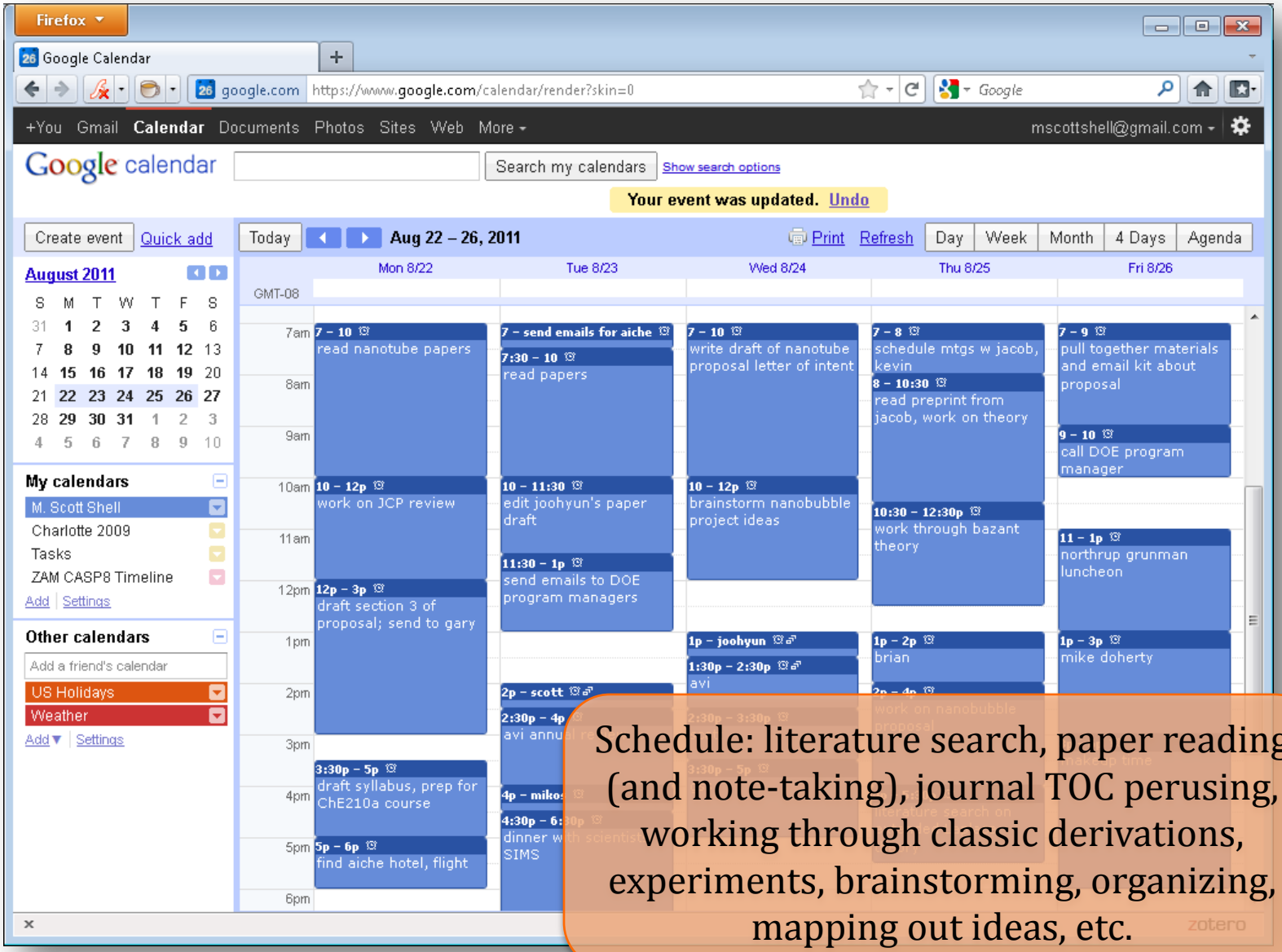
maximize k_2

research mode [RM] $\xrightarrow{k_2}$ discovery, new knowledge

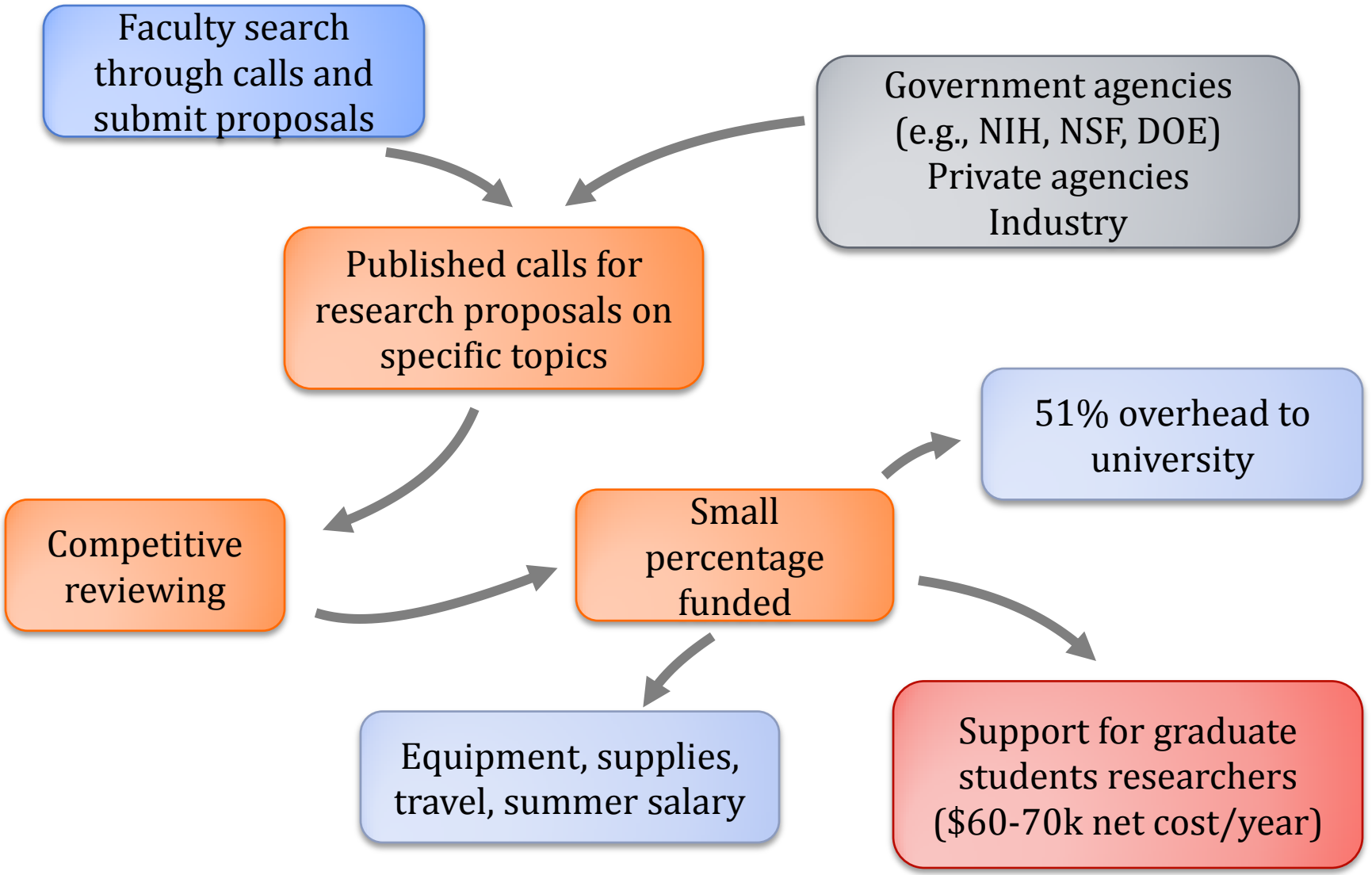
The pace of research



Never be bored or "waiting"



Schedule: literature search, paper reading (and note-taking), journal TOC perusing, working through classic derivations, experiments, brainstorming, organizing, mapping out ideas, etc.


Faculty search through calls and submit proposals
Government agencies (e.g., NIH, NSF, DOE) Private agencies Industry
Published calls for research proposals on specific topics
51% overhead to university
Competitive reviewing
Small percentage funded
Equipment, supplies, travel, summer salary
Support for graduate students researchers ($60-70k net cost/year)

A week in the life of a faculty member…

Teaching responsibilities: lecture, class prep, making exams and homeworks, office hours, grading...

	Mon	Tue	Wed	Thur	Fri
8am					
9am			class prep		
10am			class prep		
11am	class prep		**class**		class prep
12am	**class**		**class**		**class**
1pm	make HW				
2pm	office hrs	office hrs			
3pm					
4pm					
5pm					
6pm					

Admin. committees: graduate admissions, student affairs, alumni, seminars, website, promotions, fellowships, university service...

	Mon	Tue	Wed	Thur	Fri
8am					
9am			class prep		
10am		admin	class prep	admin	
11am	class prep	admin	**class**	admin	class prep
12am	**class**		**class**		**class**
1pm	make HW		admin		
2pm	office hrs	office hrs			
3pm					
4pm					
5pm					
6pm					

Scientific community: seminars, meeting with seminar speakers, conference calls with collaborators, organizing conferences...

	Mon	Tue	Wed	Thur	Fri
8am					
9am			class prep		
10am		admin	class prep	admin	
11am	class prep	admin	**class**	admin	class prep
12am	**class**		**class**	fac. lunch	**class**
1pm	make HW		admin	visitor	
2pm	office hrs	office hrs		conf. call.	
3pm					
4pm		seminar		seminar	
5pm					
6pm					

Email correspondence with: students in courses, students in group, faculty, collaborators, journals, prospective students...

	Mon	Tue	Wed	Thur	Fri
8am	email	email	email	email	email
9am			class prep		
10am		admin	class prep	admin	
11am	class prep	admin	**class**	admin	class prep
12am	**class**		**class**	fac. lunch	**class**
1pm	make HW		admin	visitor	
2pm	office hrs	office hrs		conf. call.	
3pm					
4pm		seminar		seminar	
5pm	email	email	email	email	email
6pm					

Research discussion and planning meetings with students in group and faculty collaborators

	Mon	Tue	Wed	Thur	Fri
8am	email	email	email	email	email
9am			class prep		
10am		admin	class prep	admin	
11am	class prep	admin	**class**	admin	class prep
12am	**class**	meetings	**class**	fac. lunch	**class**
1pm	make HW	meetings	admin	visitor	
2pm	office hrs	office hrs	meetings	conf. call.	meetings
3pm	meetings		meetings		
4pm	meetings	seminar	meetings	seminar	
5pm	email	email	email	email	email
6pm					

Thinking, interpreting, generating new ideas about research results and new possible directions

	Mon	Tue	Wed	Thur	Fri
8am	email	email	email	email	email
9am	**thinking**	**thinking**	class prep	**thinking**	**thinking**
10am	**thinking**	admin	class prep	admin	**thinking**
11am	class prep	admin	**class**	admin	class prep
12am	**class**	meetings	**class**	fac. lunch	**class**
1pm	make HW	meetings	admin	visitor	
2pm	office hrs	office hrs	meetings	conf. call.	meetings
3pm	meetings		meetings		
4pm	meetings	seminar	meetings	seminar	
5pm	email	email	email	email	email
6pm					

Time for random walk-in or in-the-hall discussions with students, faculty colleagues, and staff

	Mon	Tue	Wed	Thur	Fri
8am	email	email	email	email	email
9am	**thinking**	**thinking**	class prep	**thinking**	**thinking**
10am	**thinking**	admin	class prep	admin	**thinking**
11am	class prep	admin	**class**	admin	class prep
12am	**class**	meetings	**class**	fac. lunch	**class**
1pm	make HW	meetings	admin	visitor	*random*
2pm	office hrs	office hrs	meetings	conf. call.	meetings
3pm	meetings	*random*	meetings	*random*	
4pm	meetings	seminar	meetings	seminar	
5pm	email	email	email	email	email
6pm					

Anonymous reviewing of papers by other researchers, requested by peer-reviewed journals

	Mon	Tue	Wed	Thur	Fri
8am	email	email	email	email	email
9am	**thinking**	**thinking**	class prep	**thinking**	**thinking**
10am	**thinking**	admin	class prep	admin	**thinking**
11am	class prep	admin	**class**	admin	class prep
12am	**class**	meetings	**class**	fac. lunch	**class**
1pm	make HW	meetings	admin	visitor	*random*
2pm	office hrs	office hrs	meetings	conf. call.	meetings
3pm	meetings	*random*	meetings	*random*	reviewing
4pm	meetings	seminar	meetings	seminar	reviewing
5pm	email	email	email	email	email
6pm					

Editing paper drafts of graduate students and collaborators

	Mon	Tue	Wed	Thur	Fri
8am	email	email	email	email	email
9am	**thinking**	**thinking**	class prep	**thinking**	**thinking**
10am	**thinking**	admin	class prep	admin	**thinking**
11am	class prep	admin	**class**	admin	class prep
12am	**class**	meetings	**class**	fac. lunch	**class**
1pm	make HW	meetings	admin	visitor	*random*
2pm	office hrs	office hrs	meetings	conf. call.	meetings
3pm	meetings	*random*	meetings	*random*	reviewing
4pm	meetings	seminar	meetings	seminar	reviewing
5pm	email	email	email	email	email
6pm	editing	editing	editing	editing	

Reading literature papers
Writing own papers and proposals, or perhaps textbooks

	Mon	Tue	Wed	Thur	Fri
8am	email	email	email	email	email
9am	**thinking**	**thinking**	class prep	**thinking**	**thinking**
10am	**thinking**	admin	class prep	admin	**thinking**
11am	class prep	admin	**class**	admin	class prep
12am	**class**	meetings	**class**	fac. lunch	**class**
1pm	make HW	meetings	admin	visitor	*random*
2pm	office hrs	office hrs	meetings	conf. call.	meetings
3pm	meetings	*random*	meetings	*random*	reviewing
4pm	meetings	seminar	meetings	seminar	reviewing
5pm	email	email	email	email	email
6pm	editing	editing	editing	editing	**reading**
7pm		**reading**	**reading**	**reading**	
8pm					
9pm+	**writing**	**writing**	**writing**	**writing**	**writing**

Reading literature papers
Writing own papers and proposals, or perhaps textbooks

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
8am	email	email	email	email	email		
9am	**thinking**	**thinking**	class prep	**thinking**	**thinking**		
10am	**thinking**	admin	class prep	admin	**thinking**		
11am	class prep	admin	**class**	admin	class prep		
12am	**class**	meetings	**class**	fac. lunch	**class**	email	email
1pm	make HW	meetings	admin	visitor	*random*	**writing**	**writing**
2pm	office hrs	office hrs	meetings	conf. call.	meetings	**writing**	**writing**
3pm	meetings	*random*	meetings	*random*	reviewing	**writing**	**writing**
4pm	meetings	seminar	meetings	seminar	reviewing		
5pm	email	email	email	email	email		
6pm	editing	editing	editing	editing	**reading**		
7pm		**reading**	**reading**	**reading**			
8pm							
9pm+	**writing**	**writing**	**writing**	**writing**	**writing**		

Travel to scientific meetings and conferences
Seminars at other universities and departments

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
8am	email	email	email	email	email		
9am	**thinking**	**thinking**	class prep	**thinking**	**thinking**		
10am	**thinking**	admin	class prep	admin	**thinking**		
11am	class prep	admin	**class**	admin	class prep		
12am	**class**	meetings	**class**	fac. lunch	**class**	email	email
1pm	make HW	meetings	admin	visitor	*random*	**writing**	**writing**
2pm	office hrs	office hrs	meetings	conf. call.	meetings	**writing**	**writing**
3pm	meetings	*random*	meetings	*random*	reviewing	**writing**	**writing**
4pm	meetings	seminar	meetings	seminar	reviewing		
5pm	email	email	email	email	email		
6pm	editing	editing	editing	editing	**reading**		
7pm		**reading**	**reading**	**reading**			
8pm							
9pm+	**writing**	**writing**	**writing**	**writing**	**writing**		

TRAVEL

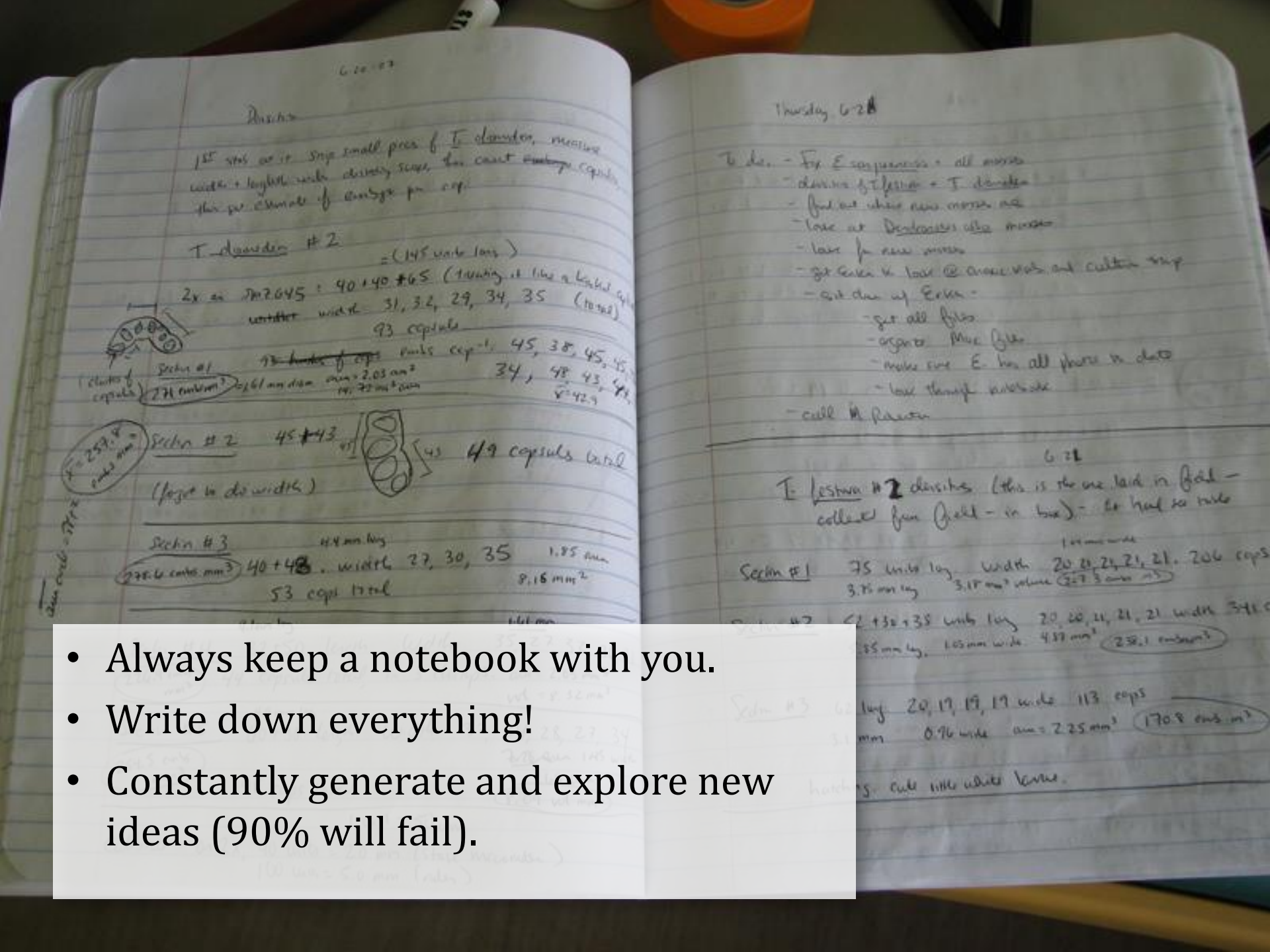
Travel to scientific meetings and conferences
Seminars at other universities and departments

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
8am	email	email	email	email	email		
9am	thinking	thinking	class prep	thinking	meetings		
10am	thinking	admin	class prep	admin	meetings	email	email
11am	class prep	admin	class	admin	class prep	email	email
12am	class	meetings	class	fac. lunch	class	thinking	thinking
1pm	make HW	meetings	admin	visitor	*random*	writing	writing
2pm	office hrs	office hrs	meetings	conf. call.	meetings	writing	writing
3pm	meetings	*random*	meetings	*random*	reviewing	writing	writing
4pm	meetings	seminar	meetings	seminar	reviewing	editing	reading
5pm	email	email	email	email	email		
6pm	editing	editing	editing	editing	reading		
7pm		reading	reading	reading			
8pm							
9pm+	writing	writing	writing	writing	writing		

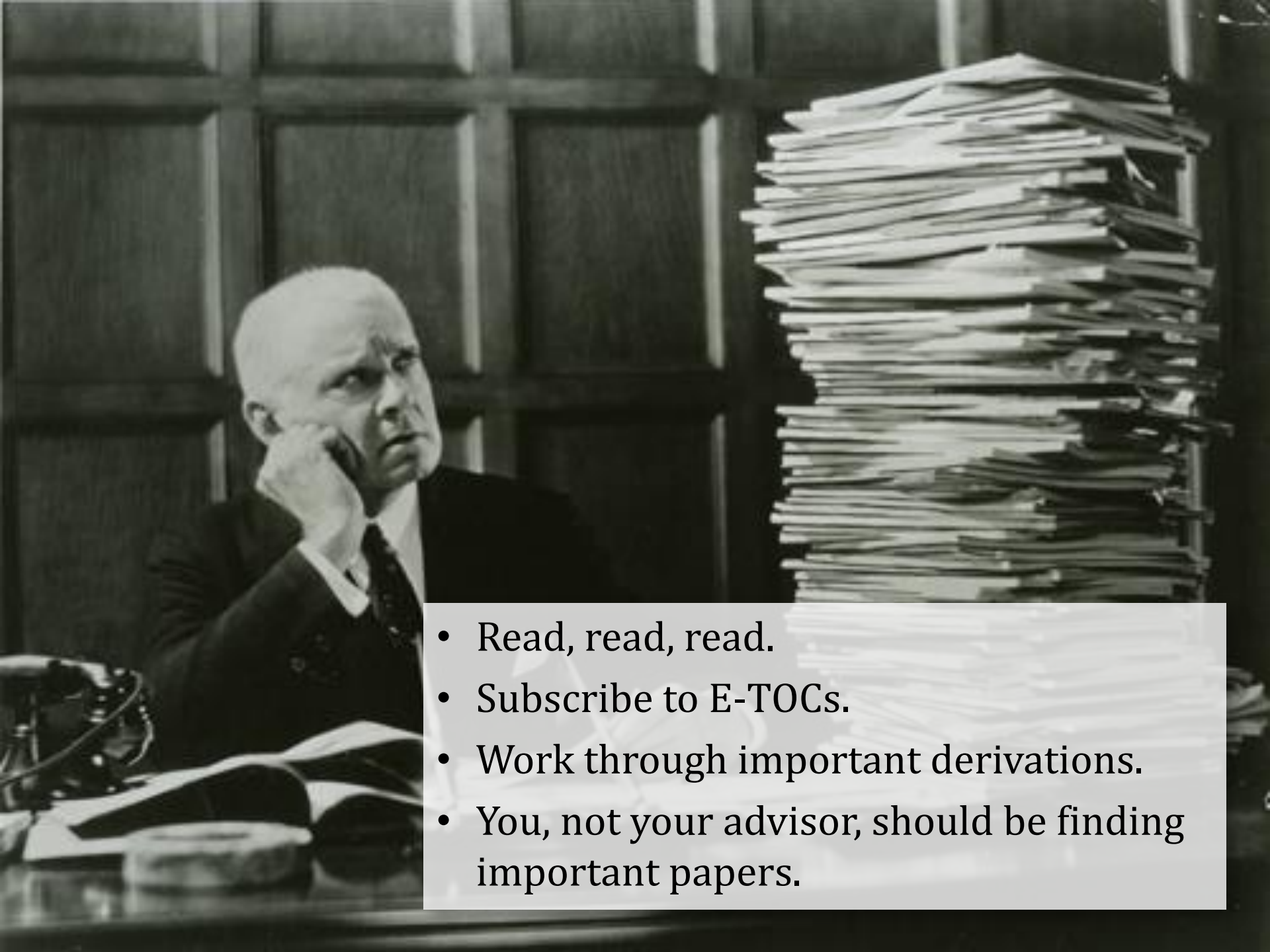
TRAVEL

How to succeed, the big picture

1. Don’t ask “what.” Ask “how.”
2. Work hard and then harder
3. **Work smart**



- Always keep a notebook with you.
- Write down everything!
- Constantly generate and explore new ideas (90% will fail).



- Read, read, read.
- Subscribe to E-TOCs.
- Work through important derivations.
- You, not your advisor, should be finding important papers.

Professional Development Series (PDS)

for Post-docs and Graduate Students

csep.cnsi.ucsb.edu/graduate/pds

Winter 2013 schedule

1) Career Talk: My 37 Years at Corning (in partnership with Corporate Programs)
2) **Preparing Figures for Publications and Presentations**
3) Career Talk: Avoiding the Fiscal Cliff After Graduate School - How I Got a Job in DC
4) Grant Writing A: Grants, Funding Agencies and Foundations: A-Z
5) Grant Writing B: Faculty Panel on Funding Programs
6) Grant Writing C: Story and Structure: the Foundation for Successful Grant Writing
7) Dress for Success: Job Interviews and Professional Attire
8) **Grant Writing D: Concise and Creative Project Descriptions**
9) A Versatile PhD: Preparing for "Alternative" Careers
10) Performance Enhancement Series A: Increase Your Emotional Intelligence
11) Employment Visas (J-1, H-1B, TN) and Green Cards: An Information Workshop
12) Grant Writing E: Writing with Coherence
13) Performance Enhancement Series B: Mindful Communication and Conflict Resolution
14) **Career Talk: Life at the intersection of Science, Technology, and Security Policy**

- Attend as many seminars as you can.
- Interact with visitors and guests.
- Take advantage of professional development workshops.

Interact! Don't go it alone!

- Student colleagues
- Faculty
- Collaborators
- Others in your field

Be prepared for challenges

- People will be smarter than you
- Few definitive mileposts and metrics
- Self-pressure to do well
- The research roller coaster

How to succeed, the big picture

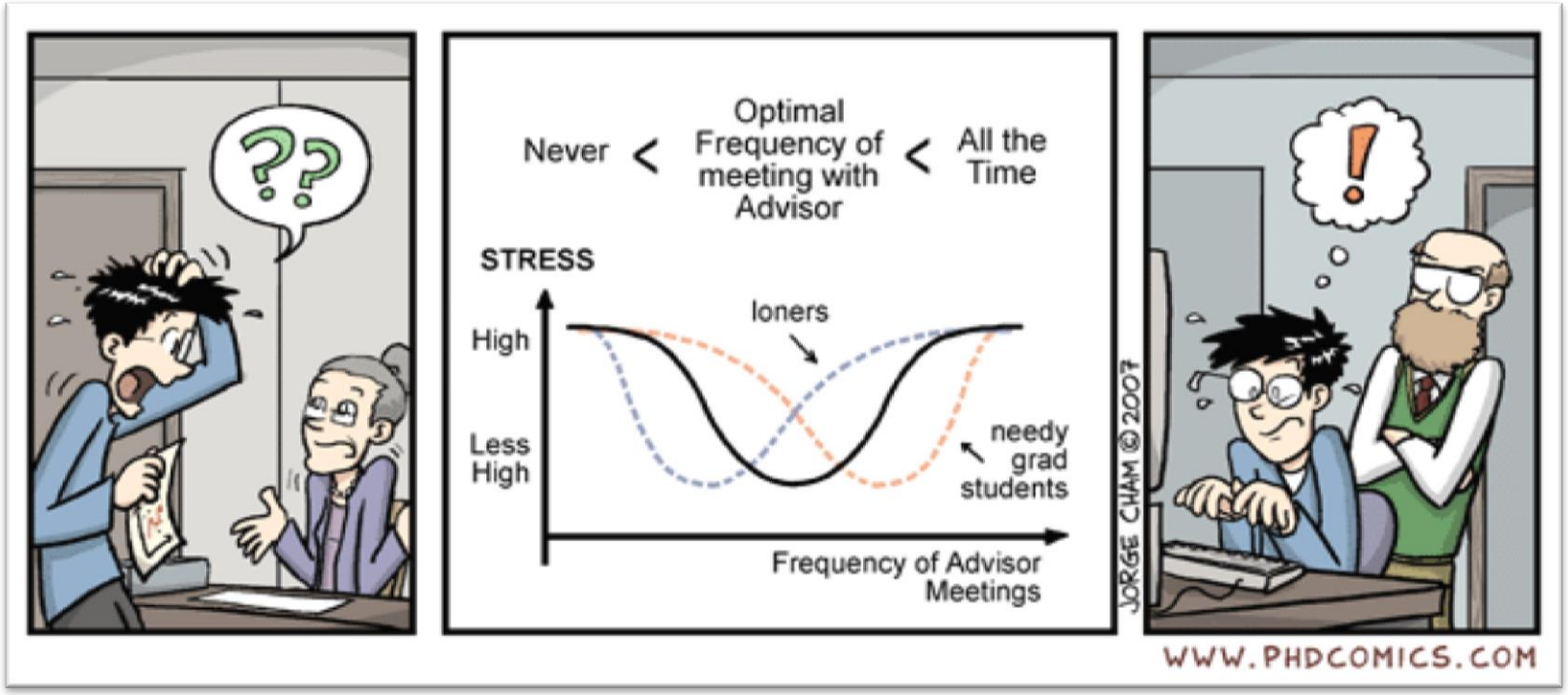
1. Don’t ask “what.” Ask “how.”
2. Work hard and then harder
3. Work smart

Some more immediate tips…

Picking a research area

- Explore all the options – the most familiar isn't necessarily the best fit
- Are the basic research questions (not just methods) interesting to you and seem important?
- What is day-to-day life like? Experiments? Simulations?
- ***All projects evolve and change*** – do you like the research area and see opportunities for growth?

Finding an advisor



What an advisor is not

- The main expert on your PhD project
- Your personal problem-solver and tutor
- Someone to tell you what to do next
- Designer of your daily task list and agenda
- Career services

What an advisor is

- A short- and long-term mentor to provide scientific and professional guidance
- A role model
- An intellectual colleague
- Someone who is well-informed of current scientific topics and methods
- Leader and administrator of a small research enterprise

Your life outside of the lab

- Develop a schedule for work, exercise, social
- Make sure time spent working is *quality*
- Know when to: take a break, buckle down, reward yourself
- Nurture hobbies and friends outside of work; be proactive

What now?

- Buy a notebook for chats, seminars, research thoughts, to-do lists… and *use* it.
- Apply to fellowships, especially NSF.
  Yes, you do have time.
- Talk, engage, ask questions, explore, become known
- Pursue every opportunity. Attend all department seminars, find other seminars, group meetings, etc.
- Be confident, not scared or timid!
  You're an elite, talented group.