The Nuts and Bolts of Academic Job Search

Jeffrey M. Karp, Ph.D.

Harvard-MIT Division of Health Sciences and Technology
Harvard Medical School
Brigham and Women's Hospital
(These slides were adapted from a presentation originally prepared by Prof. Ali Khademhosseini)

Academic Background

KEEP IN MIND

You may be a great faculty candidate,

but not fit what they are looking for

Important Links

http://web.mit.edu/career/www/graduate/academiccareers.html

http://sciencecareers.sciencemag.org/

A faculty search takes time:

Proposal: ~25-50 hrs (spread over 3-4 months)
Assembly of Application and Submission: ~ 15-20 hrs
Interview Prep: ~10-15hrs
Interviews: 1-2 days each

Remember, once you have your application assembled, it only take 1-3 hrs to modify to send to different places.

Professional Development
Strategically Stack your CV ASAP

→ **Everyone is different – highlight music, Xtracurriculars, etc**

Examples from my application

- Secured ~$1.5 million in grants
- Was head T.A. of Engineering at UofT
- Published 9 papers/chapters in PhD
- 18 papers/chapters from postdoc
- 14 technology disclosures/patents from postdoc
- Founded a Surgical Video Library
- Editorial board of a International Journal of Nanomedicine
- Awards

Where to find advertised positions?

- Academic journals (Science, Nature, etc.)
- Society newsletters, journals and websites
    - BMES, SFB, MRS, TERMIS, AIChE, ACS
- Departmental websites
- Emails to your department head/advisor
- Conference postings
- Talking / networking
- Other sources:

http://www.academickeys.com

Academic cycle

- Preparation of application packet as early as possible
- Submit application packet (Sept./Oct. – some at end of July)
- Attend field specific meetings (BMES, MRS, AIChE), during Fall
- 1st Interview (usually December to March)
- 2nd visit (usually March to May)
- Negotiate and accept/decline offer (May-June)
- Start position (July/August/Sept)
- Most decisions occur during academic year

Application package

(Ask your friends, lab mates, mentors for examples and have them review)

- Cover letter
- CV
- List of references (3-5)
- Research plan (5-20 pages)
- Teaching statement (~1 page)

What are they looking for?

Why would they pick you over the other 200 applicants?

- Great reference letters
- Publications!
- Presentations, grants/fellowships, awards
- Does your research plan fit in with their wants and needs?
- Relevant background, ability to teach core curriculum
- Pedigree
- Ability to work in multiple areas (funding)
- Grant writing experiece

PROPOSAL

Why would they pick you over the other 200 applicants?

- You should aim for a good story (VISION)
- what is hot in your field (nature, science)
- what are key limitations of your field
- complements existing expertise
- Proposal may have 3 core ideas

  5 page proposal

  1. STORY (how do three ideas connect)

  2-4. Motivation, aims, strategy (like grant)

  5. References

Proposal breakdown
Pg 1

→Introduce the problem - # people affected

→Summarize key limitations in field (3-4)

→Explain how you are uniquely positioned to address the limitations

→Summarize key innovations that need to take place or what is required for successful approach

Every year, over half a million patients in North America undergo surgical procedures to correct bone deformities or critical sized defects[1]. Although surgeons may graft exogenous bone into the lesion, failure rates with typical graft procedures may be as high as 50%[2]. Existing clinical strategies are fraught with many limitations including donor site morbidity and lack of suitable graft material. In addition, present strategies to augment or replace current therapies have three main limitations:

I) Existing bone tissue engineering scaffolds have poor mechanical properties to support bone regeneration[3].
II) Currently, there are no robust matrices that support rapid invasion of host cells and that can be easily modified with biomolecules[4].
III) Transplanted cells for enhancing bone regeneration may undergo substantial cell death[5,6].

I am interested in using engineering approaches to solve biological problems related to orthopedic and craniofacial regenerative medicine where effective strategies require the amalgamation of knowledge from areas such as nano-technology, engineering, biology, material science, drug delivery and medicine. My work at the University of Toronto and MIT has provided a solid foundation for this proposed research as a faculty member. For example, I have developed: photocrosslinkable degradable elastomer materials[7], fabrication processes for the production of composite tissue engineering scaffolds containing ceramic materials and fibrin[4,8], novel cell migration assays to assess the migration of osteoprogenitor cells[9], biological microelectro mechanical systems (bioMEMS) approaches for interrogating cell-cell interactions during bone formation[10], and tools for sensing tissues and tissue compartments[11]. I have gained valuable experience in the areas of bone tissue engineering[8,12,13] and in adult and embryonic stem cell research[12,14]. In addition, I have studied how molecules such as thrombin[9] or collections of growth factors such as those obtained from platelets[15,16] affect osteogenic cell invasion, and how the culture protocol influences the differentiation of human embryonic stem cells into osteogenic cells[14].

While I have general interest in the area of regenerative medicine and design of medical devices, in particular my research will focus on developing strategies to heal bone tissue. Given that bony wound healing requires thorough colonization of a defect site with osteogenic cells, successful strategies should include:

1) ***A tough biodegradable elastomeric scaffold or graft material that can maintain its shape under compressive and tensile forces and can accommodate the release of growth factors to stimulate cell migration, proliferation and matrix production.***
2) ***A cell invasive matrix that can support the rapid migration of host osteoprogenitor cells.***
3) ***A source of implantable osteogenic cells to accelerate bone regeneration.***

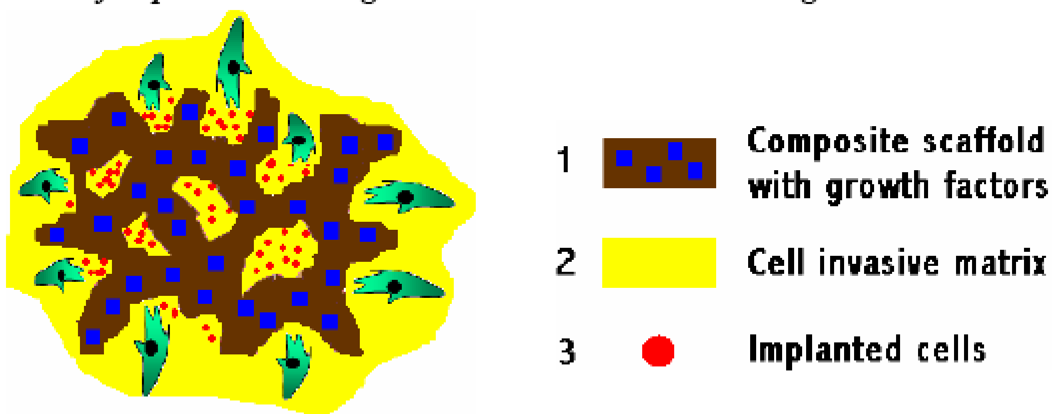


Figure 1: An ideal bone tissue engineering strategy in which a composite elastomeric scaffold is combined with growth factors, cells and a highly invasive matrix. Employing this strategy would result in the rapid invasion of host cells ( ) and the restoration of bone function.

Proposal breakdown
Pg 2-4

→ Provide a title for the project

→Motivation for the work (1/3 page)

→AIMS (3)

→Strategy (1/2 page)

→Include a figure and make sure it is 'visible'

→Typically you want: 1 Low, medium and high risk ideas

→3 separate ideas or they can be tied together

1. The Development of Biodegradable Nano-Composite Elastomeric Scaffolds and Graft Materials for Regeneration of Bone Tissue.

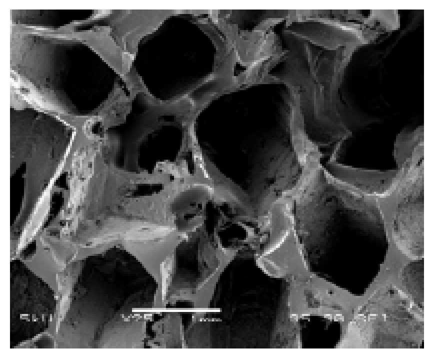
Motivation: Defects in maxillofacial bone can cause severe functional deficits and aesthetic deformities. Although first generation polymers such as poly(lactide-co-glycolide) (PLGA) have shown great potential as scaffolds for bone growth, they are far from ideal[3]. They are usually weak, lack functional groups for simple chemical modification, and often induce a foreign body giant cell response once implanted *in vivo*[17]. In addition to PLGA, materials typically used as bone graft substitutes or as bone cements lack tensile strength[18]. When designing therapeutics, one must consider the desired application and the biology of the target organ and surrounding tissues. For mandibular reconstruction, materials not only need to have suitable compressive moduli but also must be able to withstand the tensile forces exerted during mastication. Recently an ideal tough biodegradable elastomer composed of glycerol and sebacic acid was created which offers great potential as a candidate graft material[19]. This material has been shown to elicit a significantly reduced inflammatory response *in vivo* when compared directly to PLGA[19]. Whereas the rigid mechanical properties[20] and bulk degradation kinetics[21] of PLGA are sub-optimal for an implant material, poly(glycerol-sebacic acid) (PGS) degrades via a surface erosion mechanism[22], which allows for prolonged retention of mechanical properties post-implantation. To further enhance the mechanical properties of the scaffold and stimulate remodeling of the PGS into bone tissue, PGS may be combined with nanophase ceramic materials[23-25].

Aims:

1) ***Fabricate tissue engineering scaffolds and bone graft substitutes from PGS and nanophase ceramic materials and study the resultant physical properties (e.g., degradation and mechanics).***
2) ***Study the effects of combining PGS with encapsulated growth factors to stimulate osteogenesis in vitro.***
3) ***Examine the ability of these new materials to heal mandibular bony defects.***

Strategy: PGS materials are prepared through molding a minimally crosslinked pre-polymer into the desired shape followed by curing[19] or photocrosslinking reactions[7] (Fig. 2). To enhance the strength of these materials, nano-phase ceramics such as calcium phosphate, bioglass, or coral will be combined in various ratios with PGS to obtain desirable properties[23-25]. Scaffolds fabricated using this technique will be tested for both tensile and compressive properties. Once scaffolds with suitable mechanical properties have been fabricated, they will be tested in an *in vivo* drill hole defect[4,8] to determine how well they can maintain their shape and support the inward invasion of bone tissue. PGS based graft materials optimized for those physical properties will be loaded with growth factors such as thrombin peptide-508 (TP-508)[26] and/or transforming growth factor-B (TGF-β)[27] encapsulated in single or double emulsion microspheres, to stimulate cell migration and matrix production. If active growth factors cannot be successfully incorporated into photocrosslinked PGS, this problem will be solved using ammonium peroxydisulfate and N,N,N',N'-tetramethylethylenediamine as an initiation system in the absence of light. Cell invasion will be assessed *in vitro* using previously described methods[15]. In addition, incorporating factors such as RANK-L which stimulate bone remodeling may help increase the rate of regeneration[28]. The ability of the elastic scaffold/graft materials to stimulate bony regeneration will be studied in a rabbit mandibular critical defect model (12mm diameter x 5mm thick) as previously described[29]. These graft materials could ultimately be useful for healing bone deficits from congenital defects, surgical resection of cancer, or those resulting from trauma and could also be used as a replacement for allogeneic mandibular cribs[30]. They could also be designed for cancer therapy to release chemotherapeutics and growth factors to prevent tumor recurrence and healing after surgical resection.

Figure 2:
Example of a pure PGS scaffold created though a polymer curing / particulate leaching process (J.M. Karp 2005)

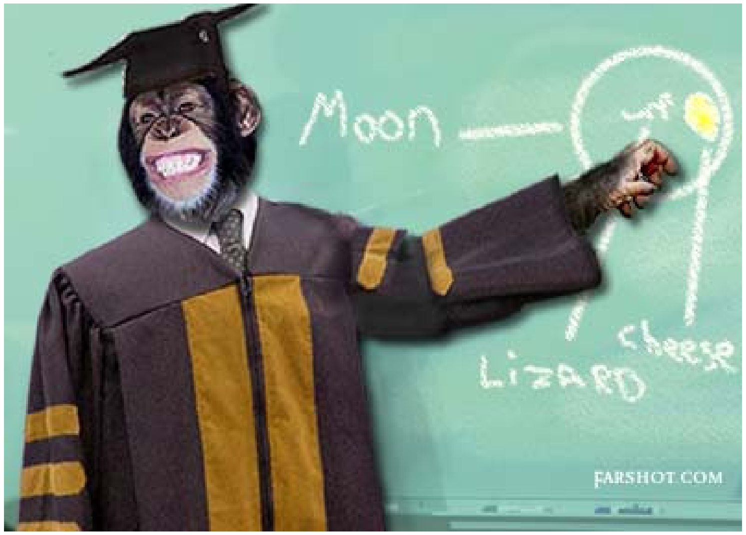


Interview day

- 1-2 days long
- 20-30 minute meetings with faculty
- Seminar
- Teaching?
- Research plan seminar (i.e. chalk talk)?
- Meetings with students
- Meetings with department head, dean

- 2nd trip usually with an offer

Interview Day Tips



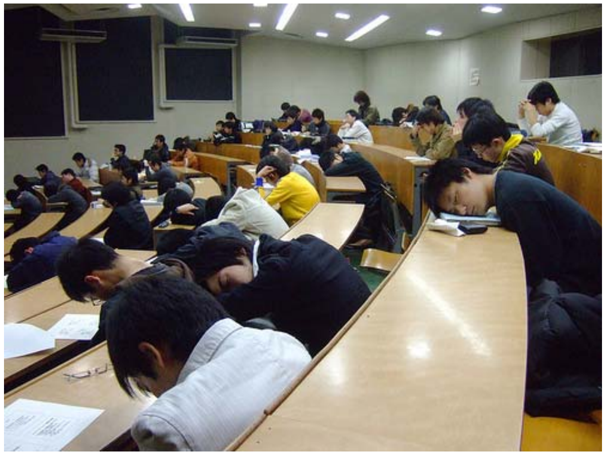
"This is the job that I have always wanted and I am going to get it"

"I am a leader in this field and have vision with a significant impact

It WILL be tiring, but also FUN…

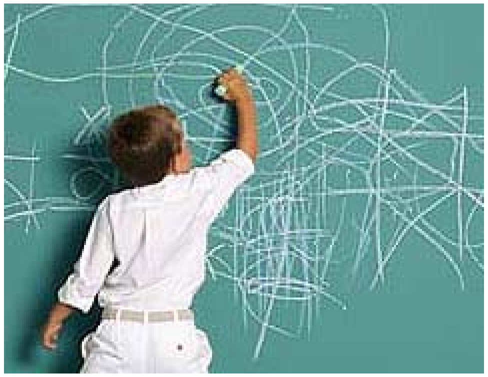
Interview killers

- Lack of enthusiasm
- Inability to interact well with the faculty
  - You are becoming a part of their family
  - Be personable
- Do not fit the vision or direction
- Do not have the background to teach



Interview killers

- Lack of original or clear research plan
  - Lacking focus and originality
  - Know the specific aims of your first proposals
  - Have a timeline about which grants and when you want to apply?
  - How is your research different than others in the field?
  - How is what you're doing significant?



What's included in the offer?

- Salary (9-months+some summer salary)
- Equipment/supplies money
- Graduate student support
- Lab space
- Reduced teaching load during 1st year

- Get everything in writing!

Additional things to consider

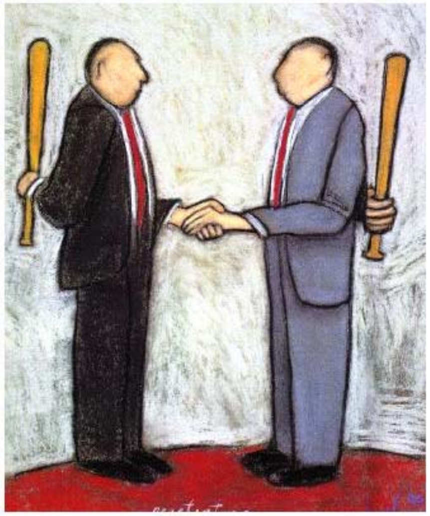
- Room to expand in the offer commensurate with indirect costs
- Administrative support
- Ability to be diverse in research
- Mentorship from senior faculty
- Proximity of lab space

“Negotiation” Time

Talk to your friends and mentors and LISTEN

Figure out: what is considered “reasonable”?
<u>what you need to succeed?</u>

Find out: lab space considerations
salary for grad students and others
startup



Sign it

&

Let the fun begin ☺

Acknowledgements

- Mentors
  - Prof. Robert Langer
  - Prof. Molly Shoichet
  - Prof. John Davies
  - Prof. Jaro Sodek
  - Prof. Bill Stanford
  - Others…
- Peers
  - Langer lab
  - Prof. Ali Khademhosseini
  - Prof. Jason Burdick
  - Prof. Steve Little
  - Prof. Gil Kaplan
  - etc.

- Departments that gave me interviews ☺

Questions?