Applications of Imaging Technologies in ~~Diagnostic~~ Medicine

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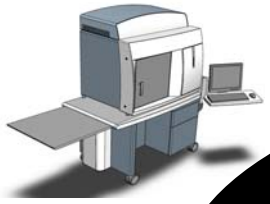
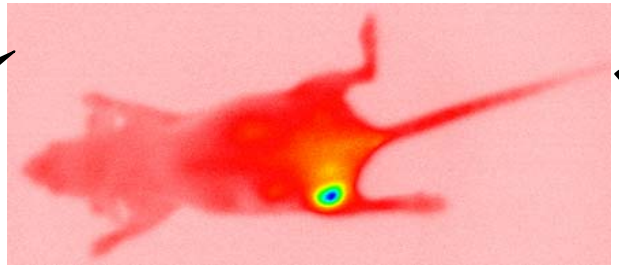
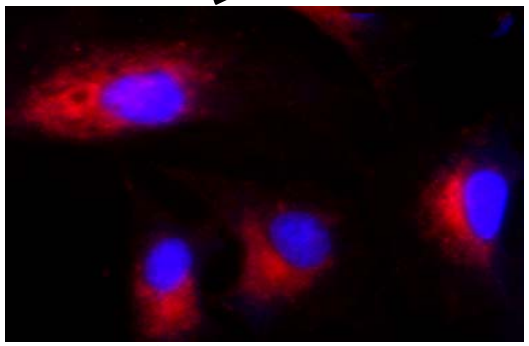
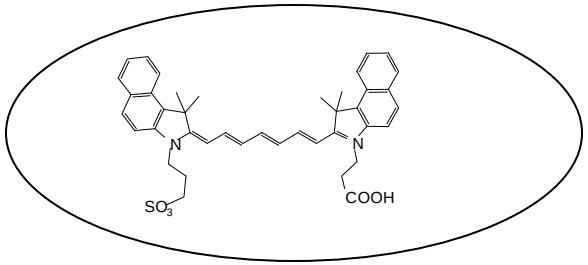
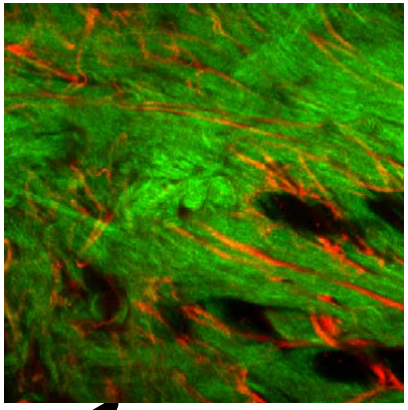
Overview

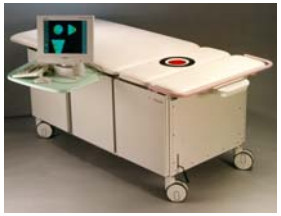




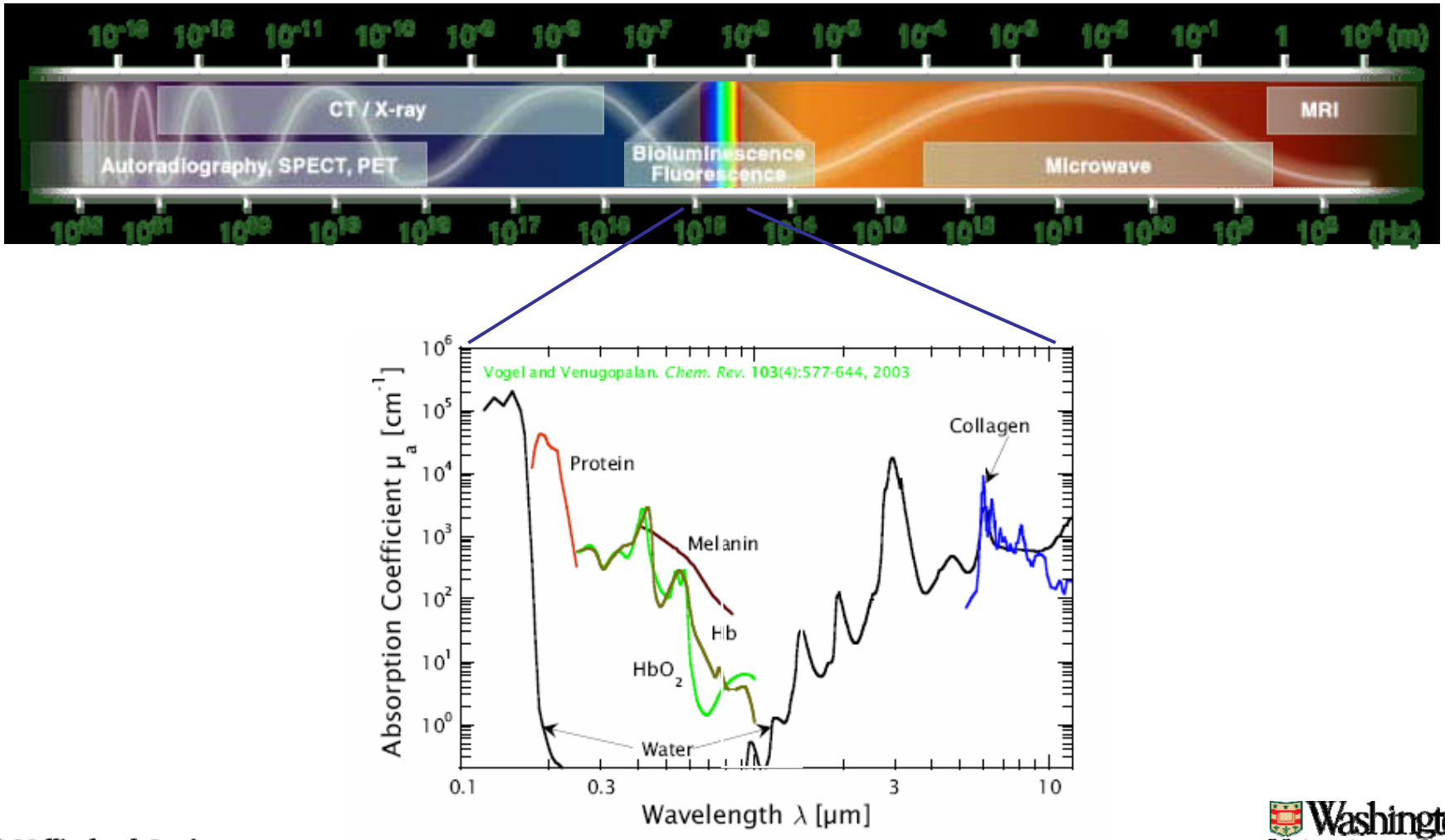








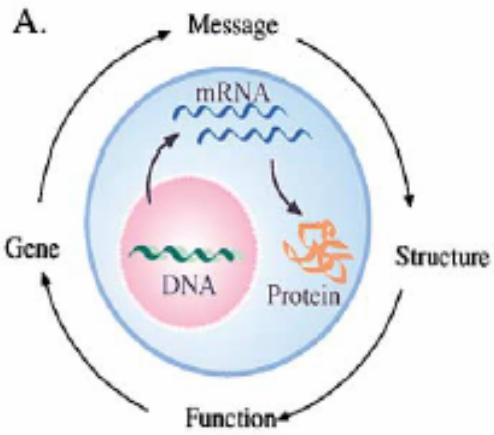
Imaging modalities

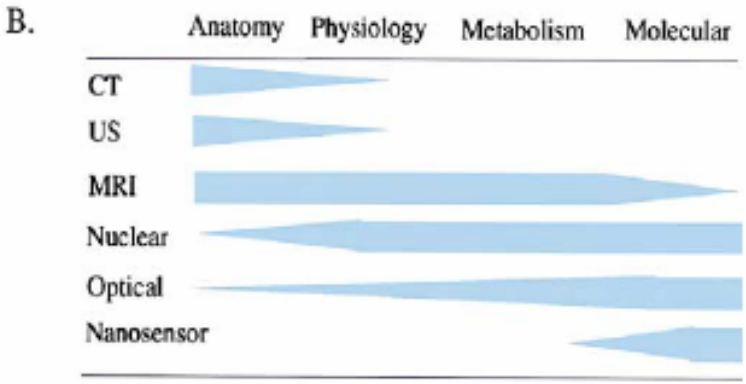


The evolution of diagnostic imaging

PAST | **PRESENT** | **"FUTURE"**

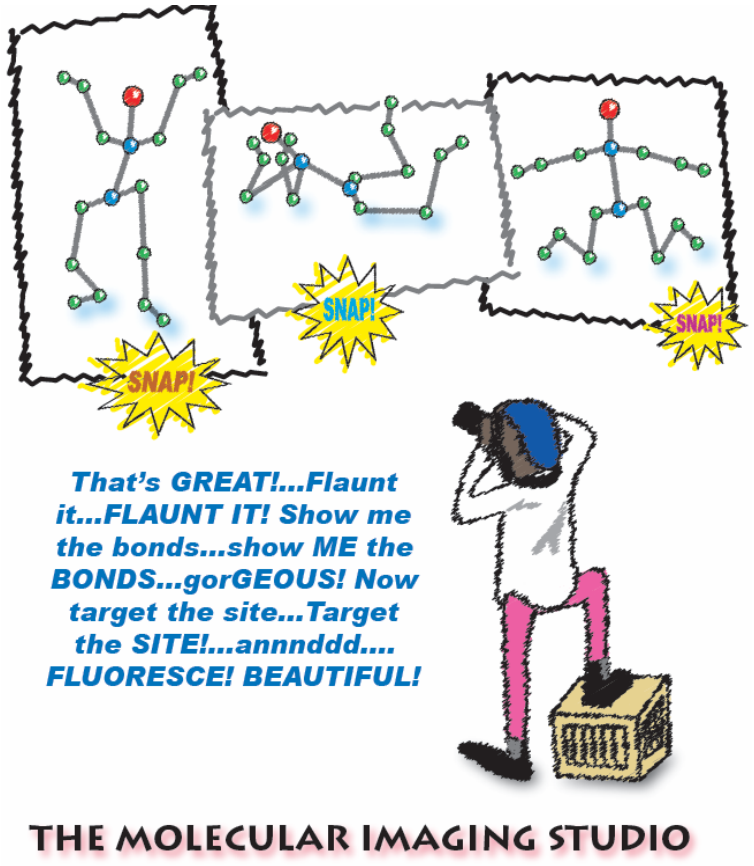
ANATOMIC	*PHYSIOLOGIC*	*MOLECULAR*
CT, MR, US	+NUCLEAR	+OPTICAL





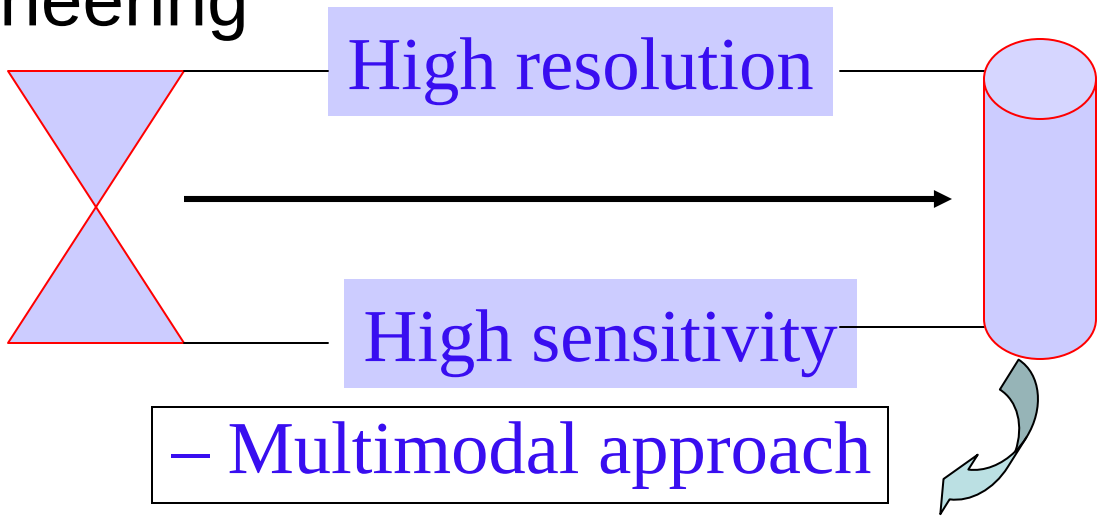
Molecular imaging

- Minimally invasive depiction, characterization, and measurement of biological processes at the cellular and molecular levels of living organisms (Hilman &Neiman, Radiol. 2002)
- In vivo characterization and measurement of biological processes at the cellular and molecular level through the use of imaging devices (Wagenaar, et al. Acad. Radiol. 2001)



Challenges

- Physics/Engineering



- Biology

Up-regulated expression ⟶ Unique expression

– Amplification mechanisms in vivo

Challenges

- Chemistry

  Generic products ⟶ Disease-specific products

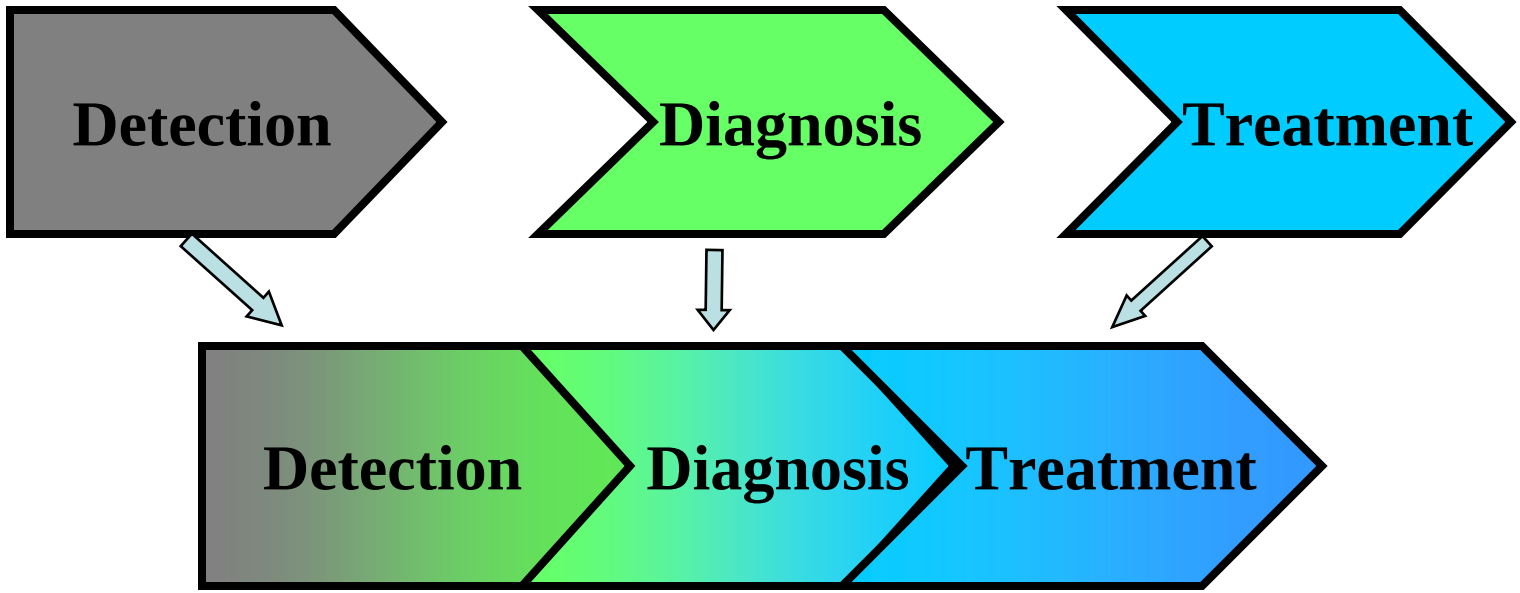
  – Smarter molecules utilizing genomics/proteomics data

Clinical use of molecular imaging

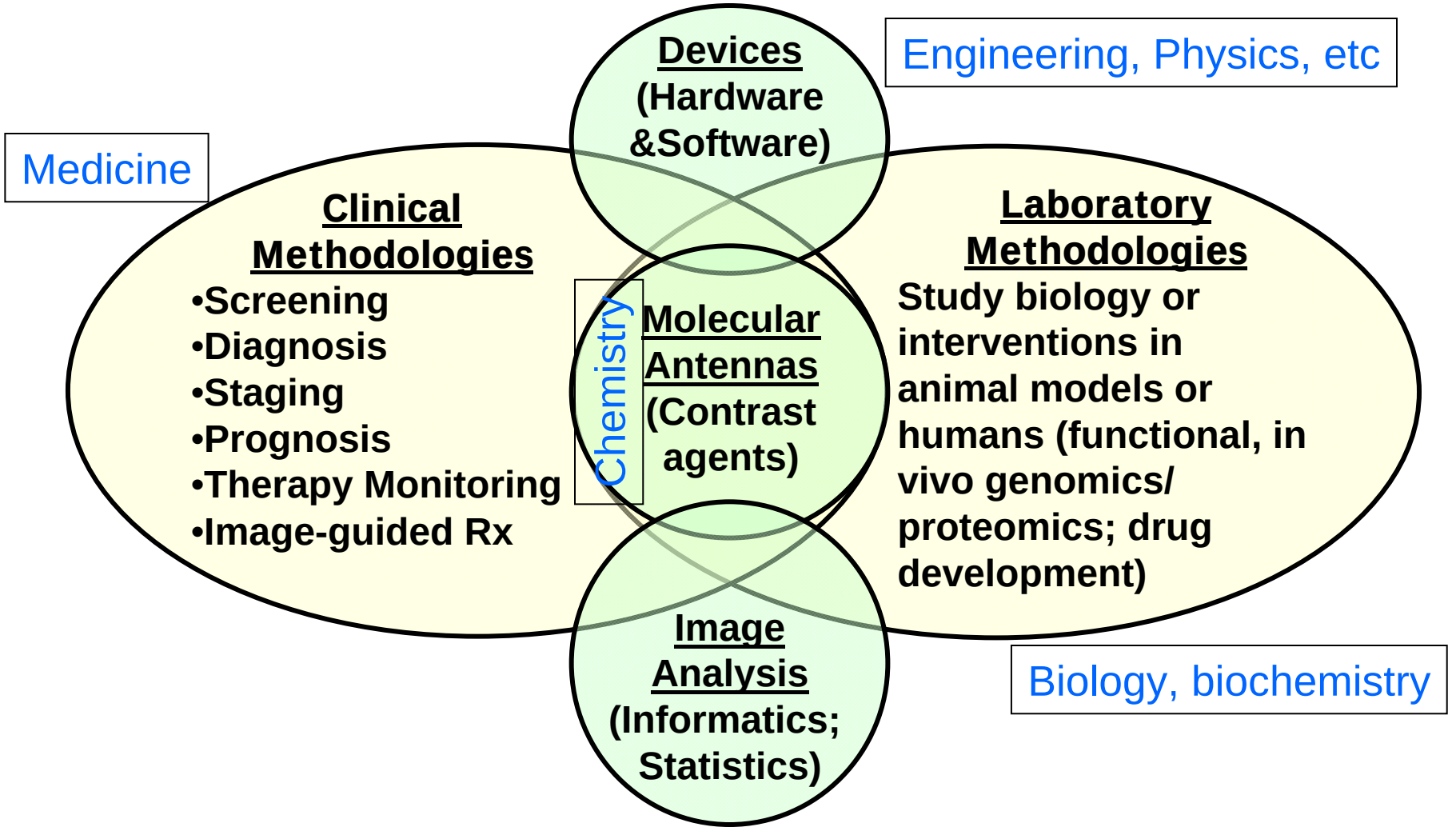
- Driven by biological questions
  - Individualized therapy
  - Specific targeting
  - Reduced toxicity
  - Earlier measures of treatment efficacy
  - Specific measures of drug action
  - Quantitative surrogate endpoints for clinical trials

- Assess
  - Expression of molecular target
  - Functional status of molecular target
  - Specific molecular pathways relevant to molecular target

Imaging in integrated care



Imaging: A multidisciplinary task



Manpower needs

How do we train the next generation of Imaging Scientists?

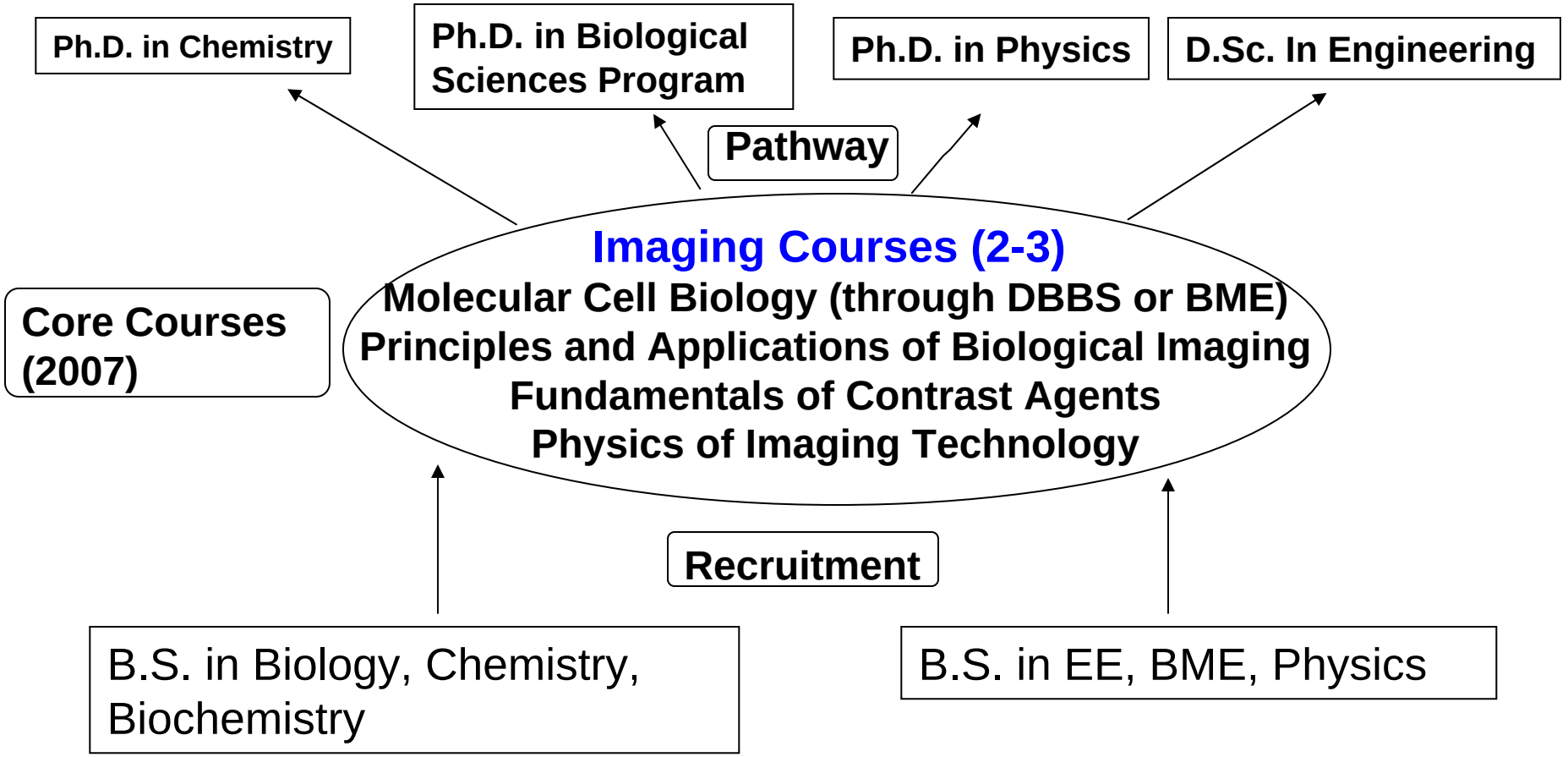
Multi- *vs* inter-disciplinary research

- **Multi-disciplinary**: a group of researchers with differing expertise contributing to a project, and then returning to doing research in their specific expertise
- **Inter-disciplinary:** a group of researchers incorporating multidisciplinary insights to develop integrated knowledge base of a complex problem that transcends constituent disciplines

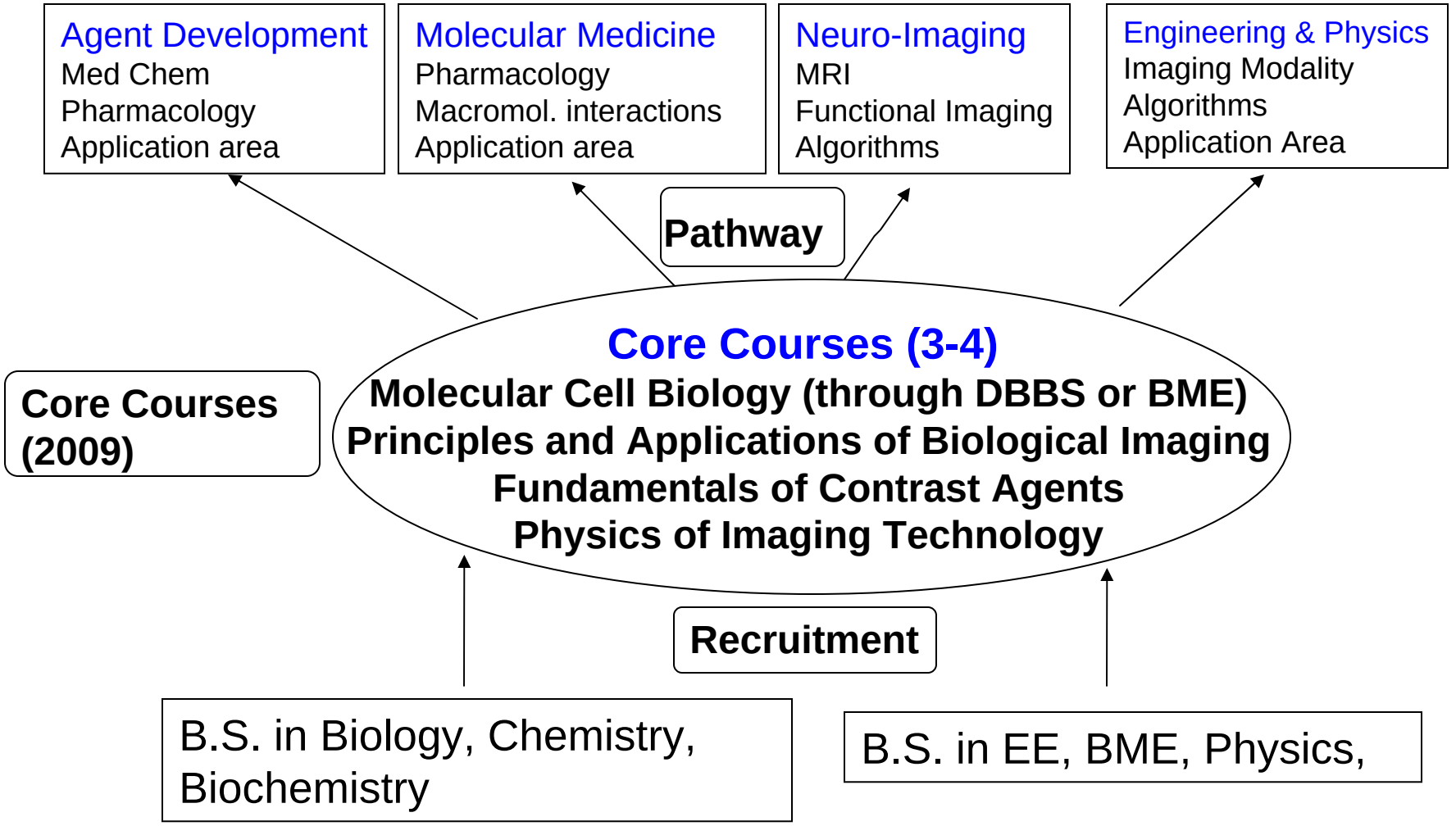
NIH roadmap initiatives for training an interdisciplinary workforce

- Develop interdisciplinary curriculum
- Undergraduate, graduate and postdoctoral interdisciplinary training
- Create interdisciplinary research teams
- INTEGRATION of disciplines is key

Imaging sciences pathway at WUSTL



Ph.D. in imaging sciences at WUSTL



Challenges of interdisciplinary training

- Lack of undergraduates with interdisciplinary training
- Teaching interdisciplinary courses to students from diverse academic backgrounds
- Encouraging interactions between faculty members of different disciplines
- Resolving administrative and educational cultural differences

Addressing Challenges

- Make undergraduate education in Imaging Sciences a priority
- Encourage inter-department and inter-school interactions
  - Jointly sponsor seminars, retreats and workshops
  - Involve faculty from different schools in teaching and curriculum development
  - Require students to have two mentors from two different disciplines (one primary and one secondary)

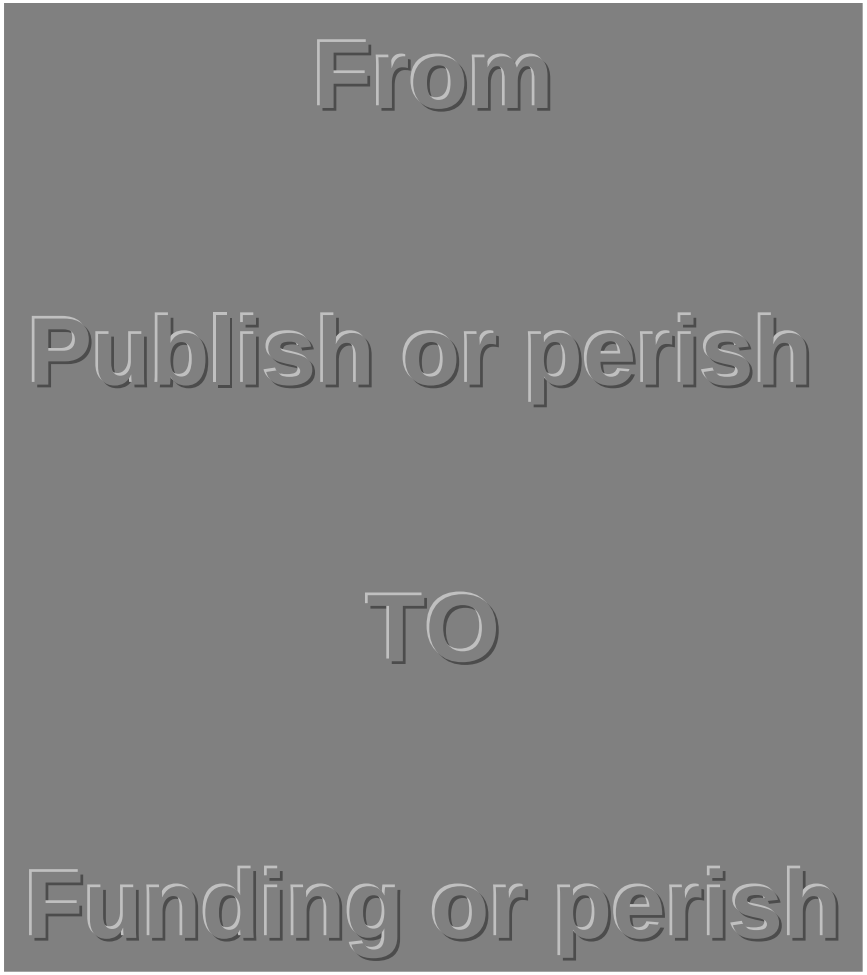
Where do we go from here?

- Create a foundation for interdisciplinary pathways and programs
- Break down administrative, financial and academic barriers to create a new educational paradigms
  - Resolve disparities in stipends, payment of tuition, and financial models between programs
- Create and sustain an imaging sciences community at US universities

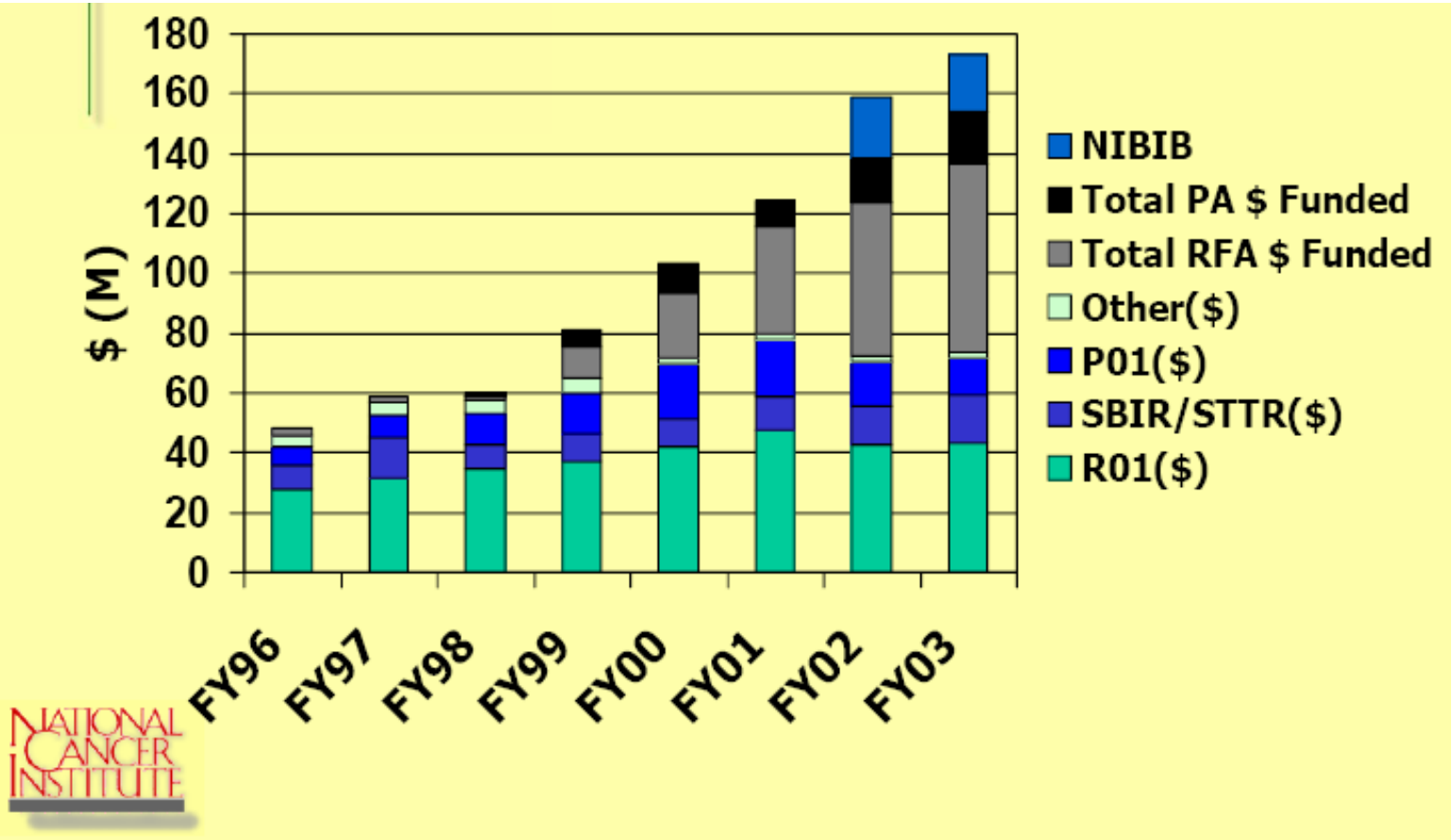
Rewards of interdisciplinary training

- Integrate disciplines (physical and biological sciences with math and engineering)
- Develop a new generation of interdisciplinary scientists with both didactic and practical training
- Facilitate communication among scientists across disciplines
- Accelerate scientific discoveries and innovation

Innovation scales with funding

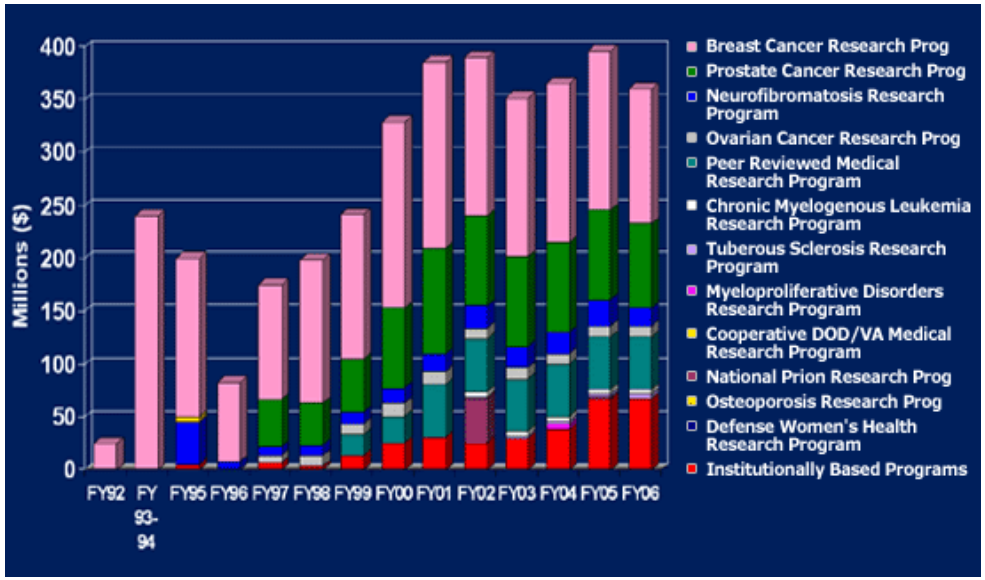


Cancer imaging grant funding

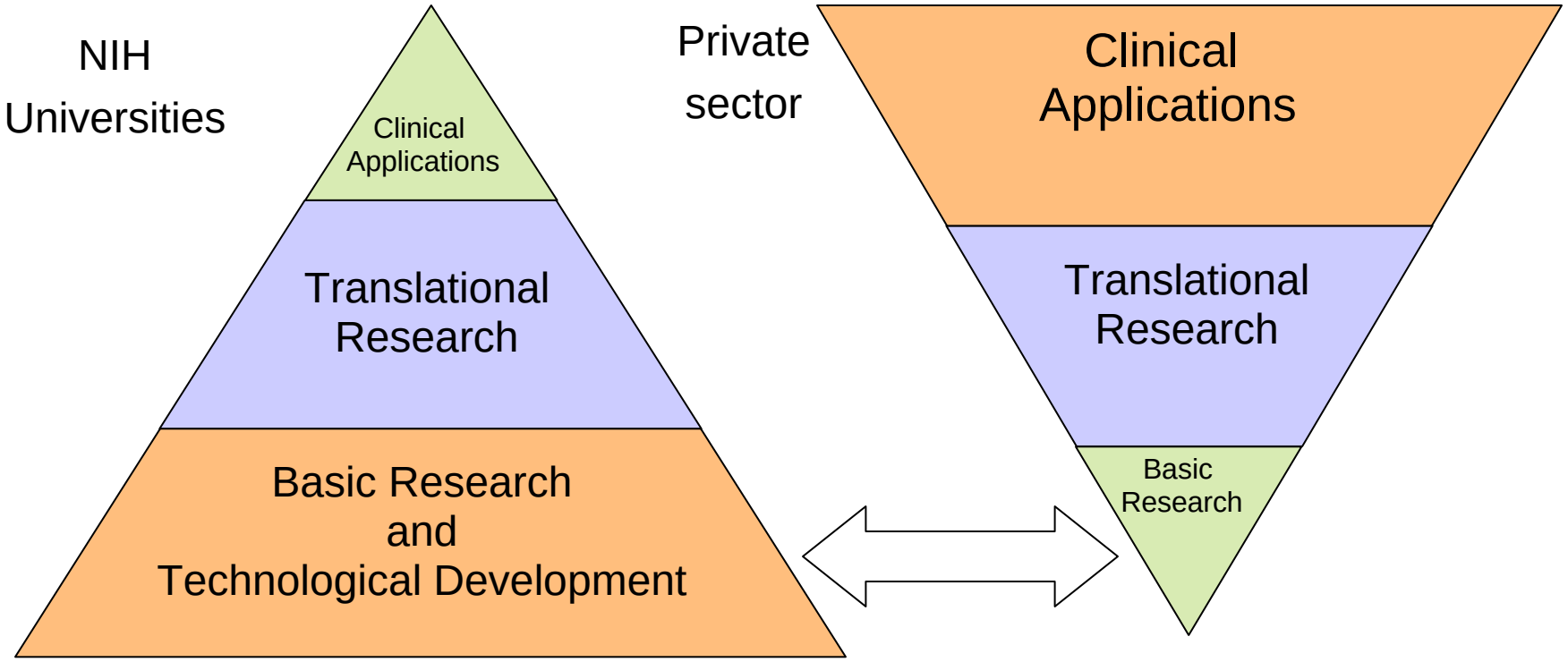


Discussion points

- To what extent should the government support interdisciplinary training?
- Do we have strong public support?
  - Breast cancer consumer advocacy community

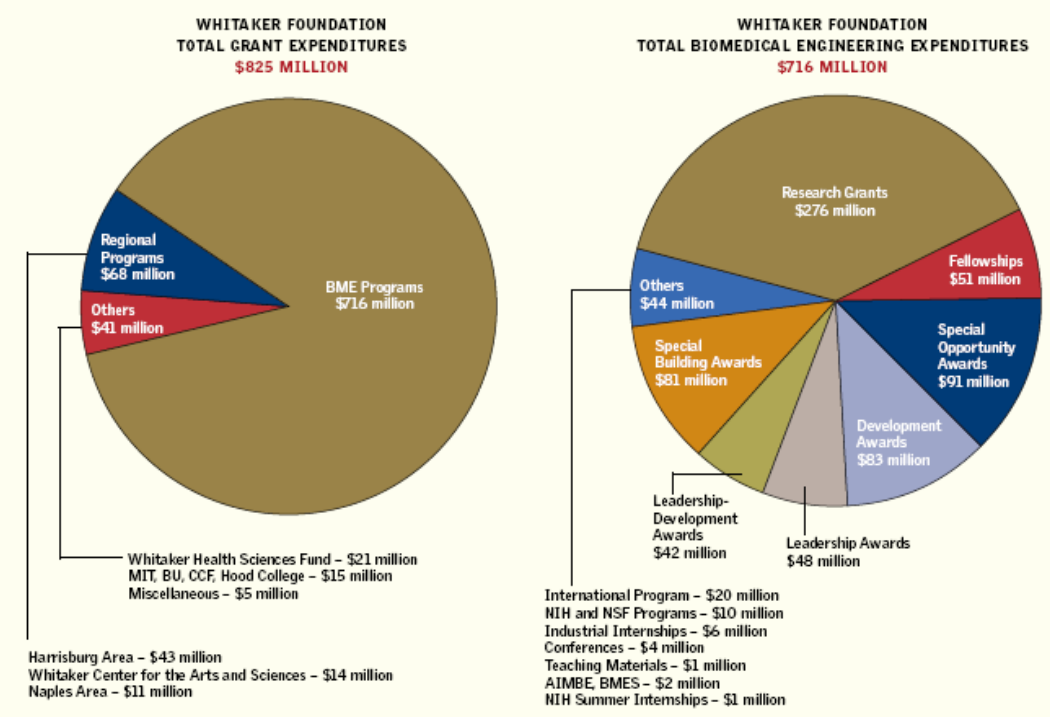


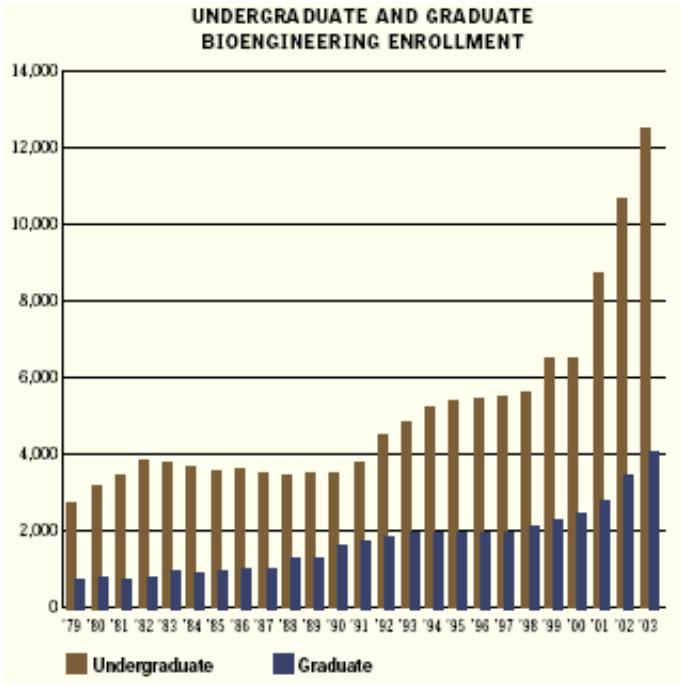
What about academe-industry involvement?



Could Foundations champion new programs?

- BME and Whitaker Foundation





Summary

- Molecular medicine era has arrived
- Patient management will be guided by molecular imaging
- Opportunities to create interdisciplinary imaging science exist
- A new breed of scientists is needed