



# Co-located Science & Engineering Programs – Models for Shared Success: Collaboration / Shared Resources / Higher Productivity

Presented by:

**Bill Gustafson, FAIA**  
**Craig S. Spangler, AIA**  
**Jeff French, FAIA**

**Tradeline**  
**Scottsdale, AZ**  
**October 13-14, 2011**

**BALLINGER**



# Agenda

- The Evolving Picture
- Long Term Factors Driving Science & Engineering
- The Challenge of Integrating Science & Engineering
  - *Grove City College: Science & Engineering Building*
  - *The George Washington University: Science & Engineering Hall*
  - *University of Wisconsin: Wisconsin Institutes for Discovery*
- Synergies & Concepts
- Discussion

# The Evolving Picture: Science & Engineering

EVOLUTION OVER TIME



EVOLUTION OF TEACHING & RESEARCH

**Wall of Resistance: Culture**



**Department • Identity • Home Base • Career Track • Comfort Zone**





Compatibility



# Long Term Factors Driving Science & Engineering

- Re-thinking the Nature of Research & Teaching
- Push for Higher Utilization
  - *Multi-Purpose vs. Single-Use*
  - *Shared Space & Equipment*
- Measurable Outcomes
  - *Teaching / Learning Styles*
  - *Research Productivity: Agility*
- Interdisciplinary Synergies
  - *Departments, Disciplines, Buildings: Campus and Beyond*
- Scalability of the Idea
  - *Undergraduate / Graduate / Post-Doctorate*

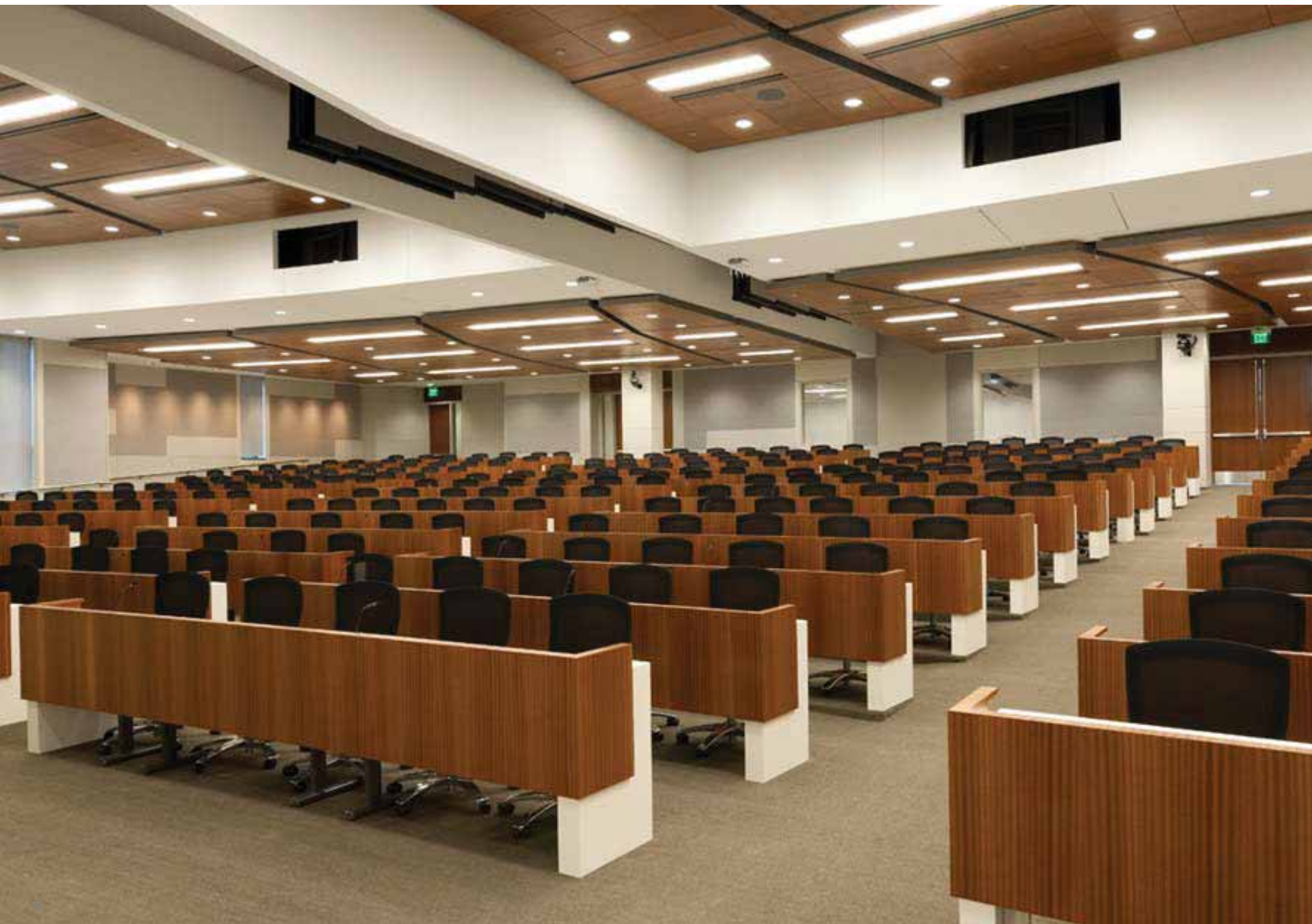


---

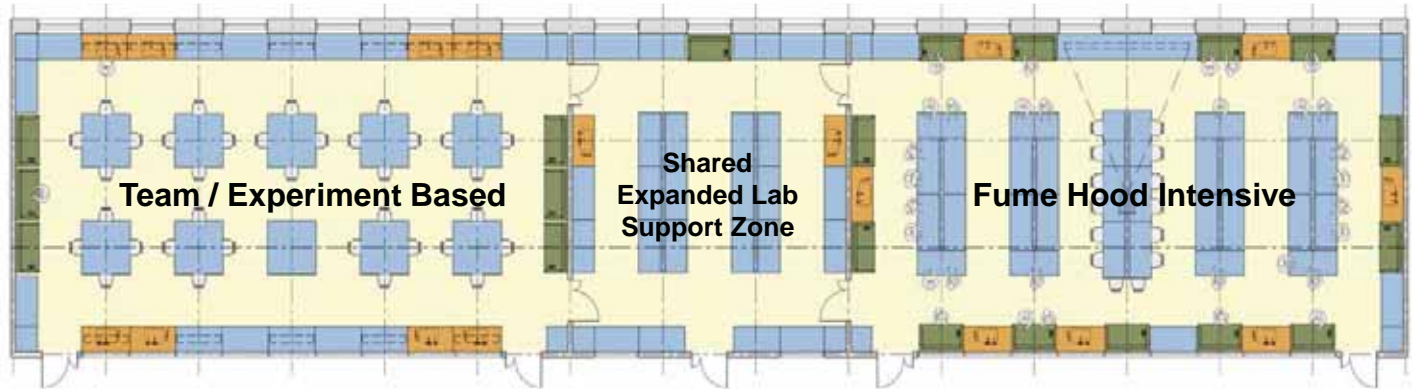
## A Changing Paradigm



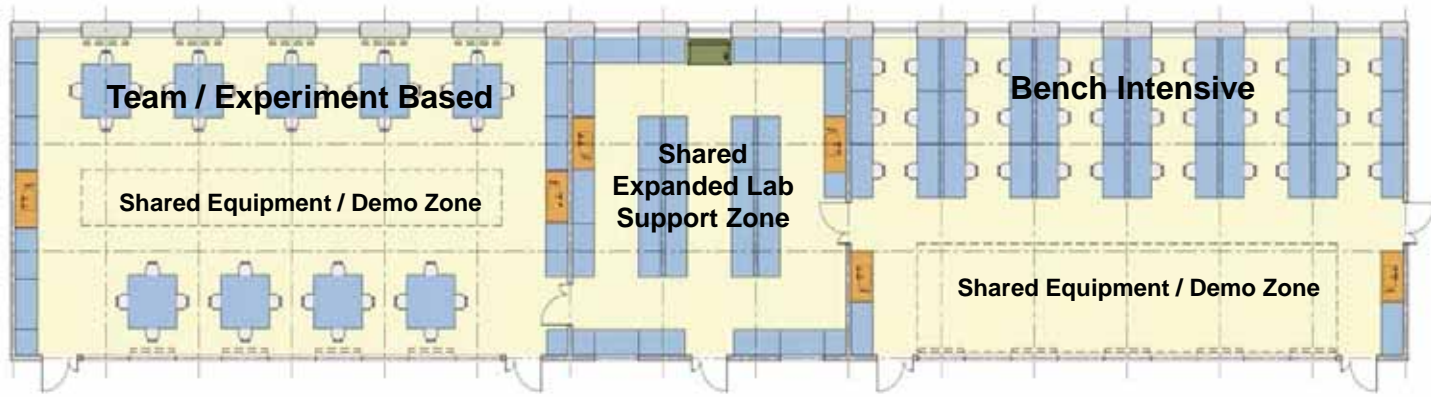
# Maximizing Utilization of Space: Move Beyond Single Use Spaces



# Teaching Lab Utilization / Flexibility



Sciences  
Studio Teaching Lab



Engineering  
Studio Teaching Lab



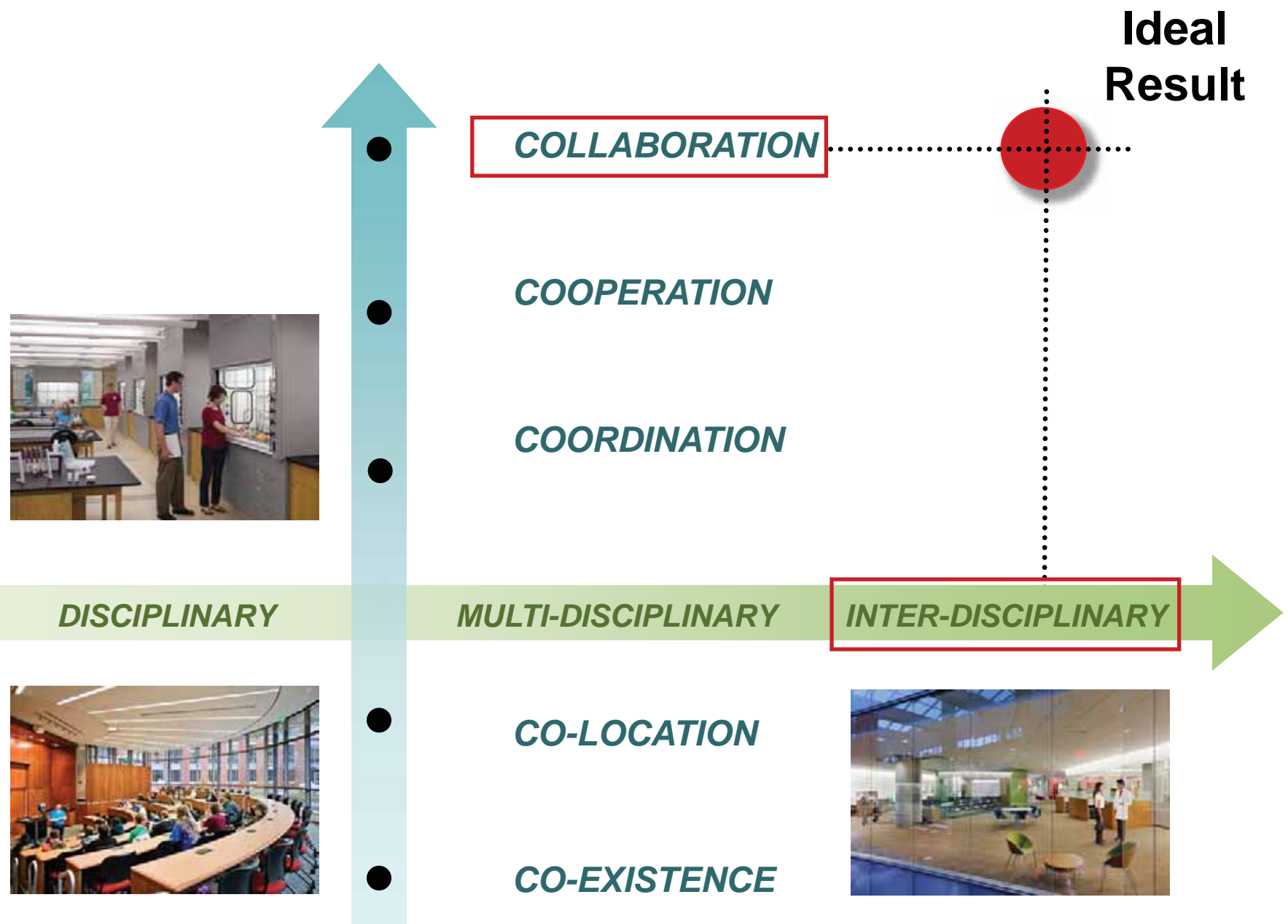


# Maximizing Utilization of Space: Move Beyond Single Use Spaces





# Interdisciplinary Collaboration



# Integrating Science & Engineering into Architecture





# Varying of Scales of Learning



# The Challenge of Integrating Science & Engineering

- **Grove City College**

- 2,700 Students
- Undergraduate Focus
- *Teaching Focus with Research*

- **The George Washington University**

- 20,000 Students
- Undergraduate & Graduate
- *Teaching & Research Focus*

- **University of Wisconsin**

- 42,000 Students
- Graduate & Post-Graduate
- Research Focus with Embedded Teaching





# The Challenge of Integrating Science & Engineering

- **Grove City College**

- Undergraduate Focus
- 2,700 Students
- *Teaching Focus with Research*

- **The George Washington University**

- 20,000 Students
- Undergraduate & Graduate
- *Teaching & Research Focus*



- **University of Wisconsin**

- 42,000 Students
- Graduate & Post-Graduate
- *Research Focus with Embedded Teaching*

# The Challenge of Integrating Science & Engineering

- **Grove City College**

- 2,700 Students
- Undergraduate Focus
- *Teaching Focus with Research*

- **The George Washington University**

- 20,000 Students
- Undergraduate & Graduate
- *Teaching & Research Focus*

- **University of Wisconsin**

- 42,000 Students
- Graduate & Post-Graduate
- *Research Focus with Embedded Teaching*







- **Context:**

- Upper Tier *Undergraduate* Institution
- Single Dean for Science & Engineering

- **Future:**

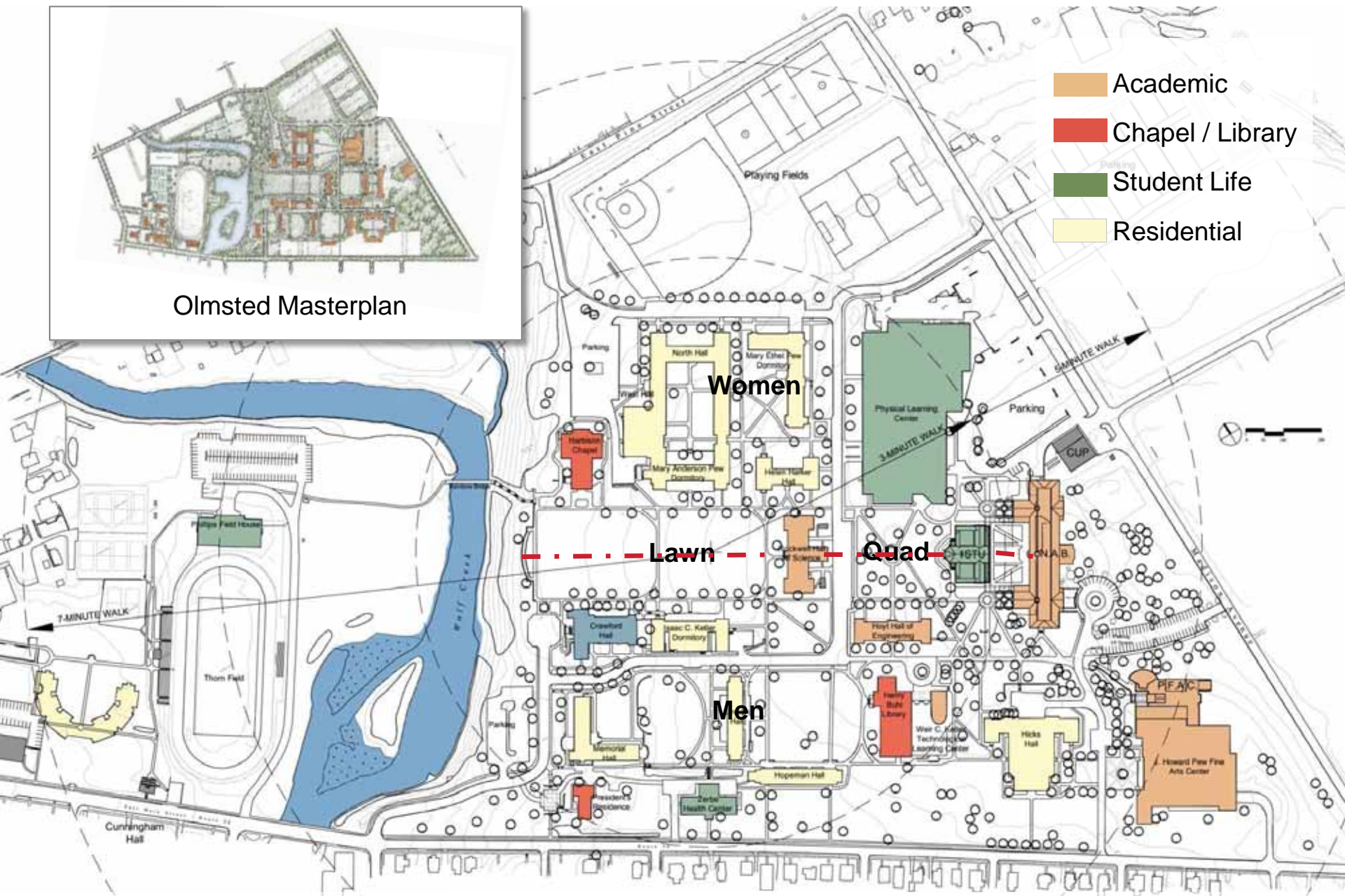
- Realize Vision of a Consolidated Facility for Science & Engineering
- Make Research an Integral Component of the Learning Experience
- Conceive of the Building as a Mentoring Tool
- Connect Science & Engineering Community with Campus Community
- Flexible Environments
- Shared Services For Efficiency



# Existing Campus

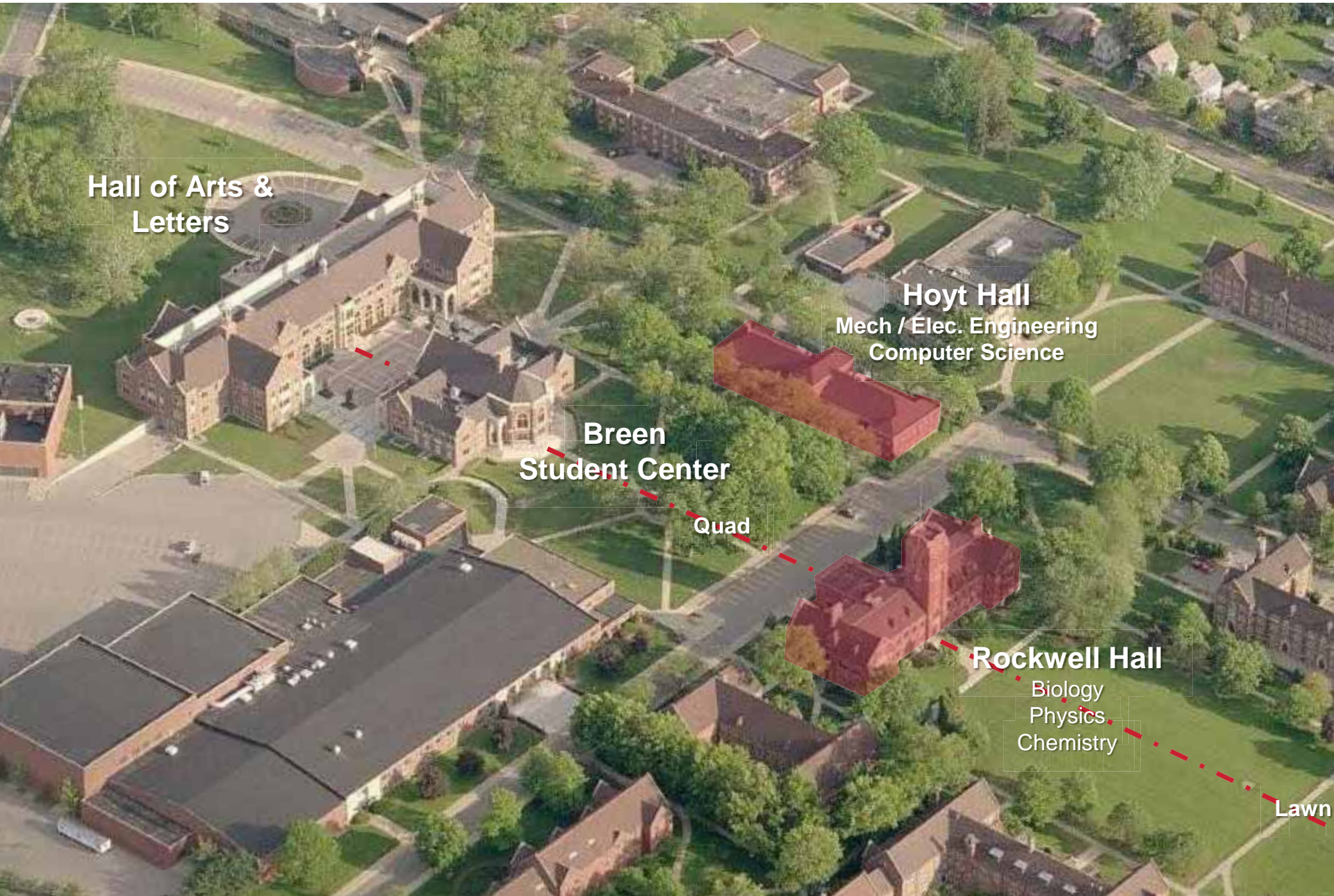


- Academic
- Chapel / Library
- Student Life
- Residential





# Restoration of Olmsted Masterplan



Hall of Arts & Letters

Hoyt Hall  
Mech / Elec. Engineering  
Computer Science

Breen  
Student Center

Quad

Rockwell Hall  
Biology  
Physics  
Chemistry

Lawn



# Strategies Considered

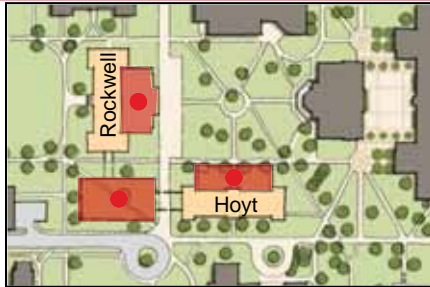
## Masterplan



- *Intensive Additions to Rockwell & Hoyt*

## 1

## Linkage



- *Smaller Additions to Rockwell & Hoyt*
- *New Link Building*

## 2

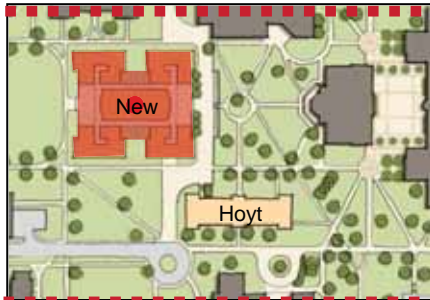
## Consolidation @ Perimeter



- *Consolidate Into Hoyt Replacement*
- *Renovate Rockwell For Other Use*

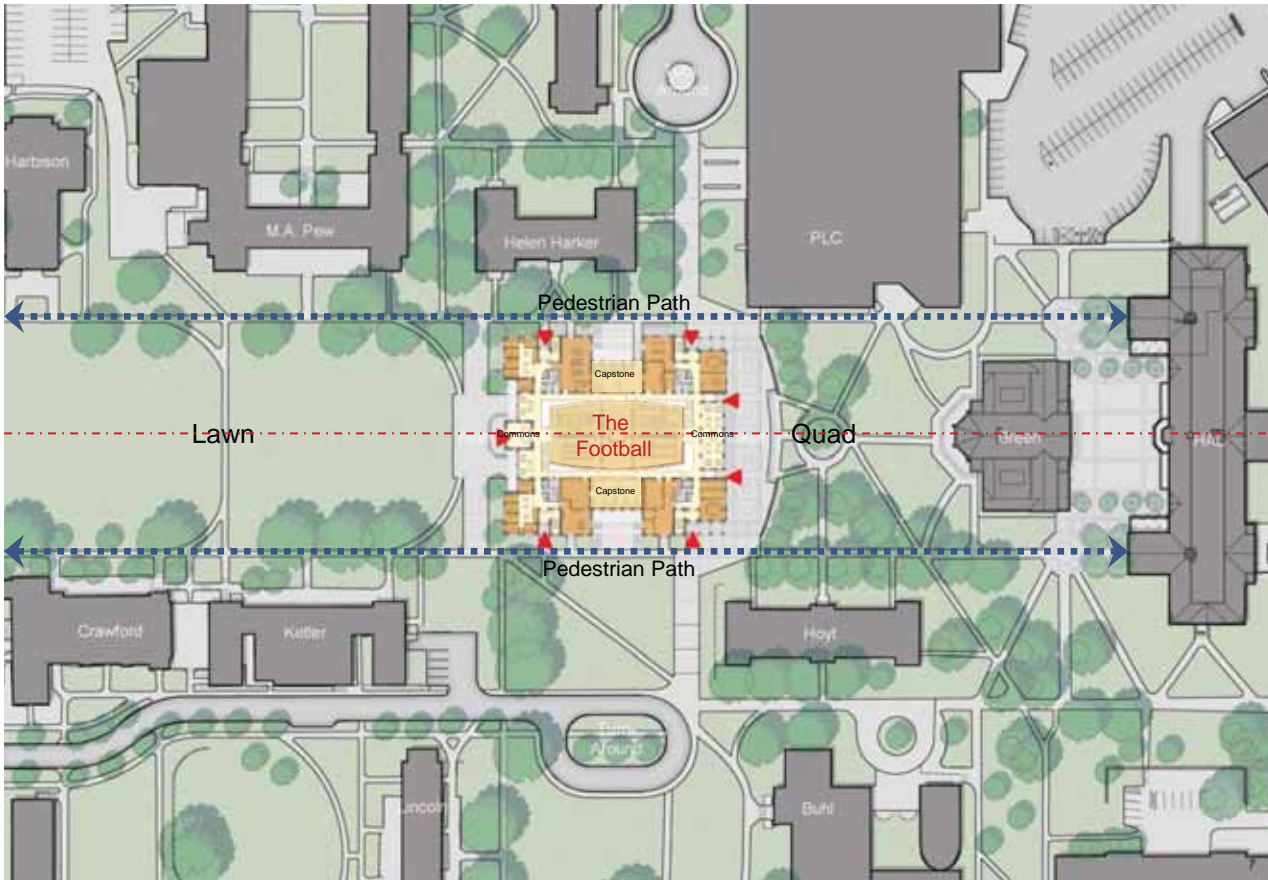
## 3

## Consolidation @ Crossroads



- *Consolidate Into Rockwell Replacement*
- *Renovate Hoyt for Other Use*

# Site Plan: Consolidation @ Crossroads



Site Plan



Aerial View at Quad



Aerial View at Lawn

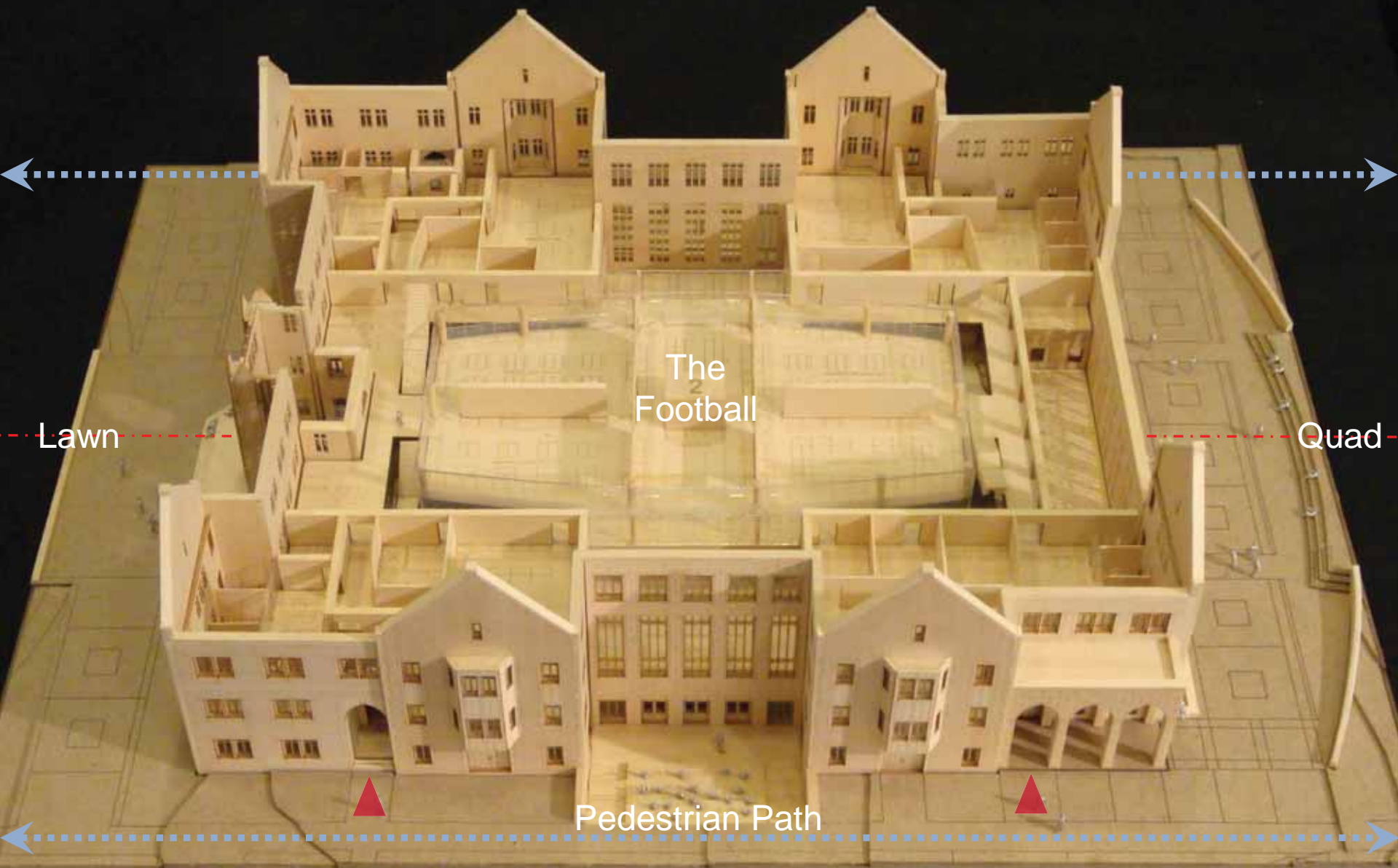
Lawn view



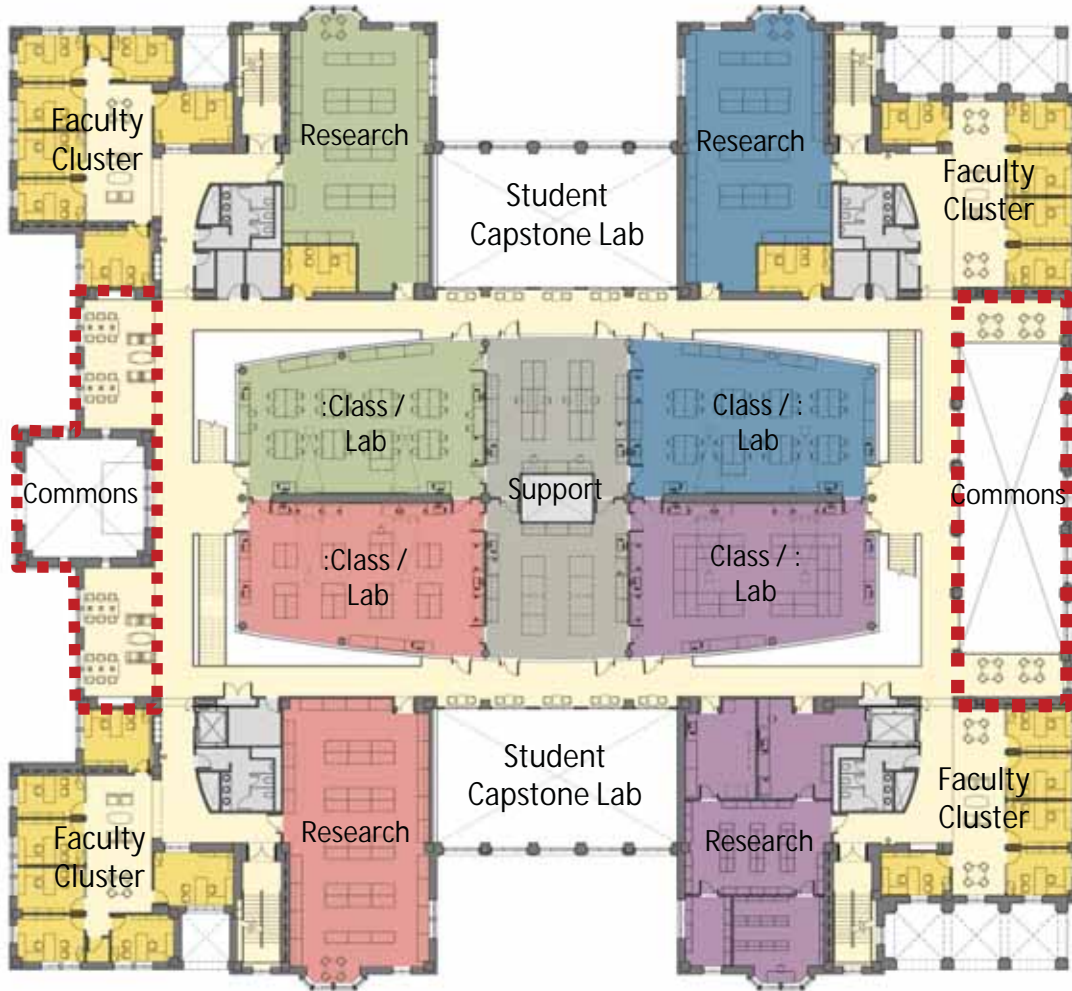
Quad View



# Consolidation @ Crossroads: Connecting to the Campus Community



# Integrated Environment: Commons



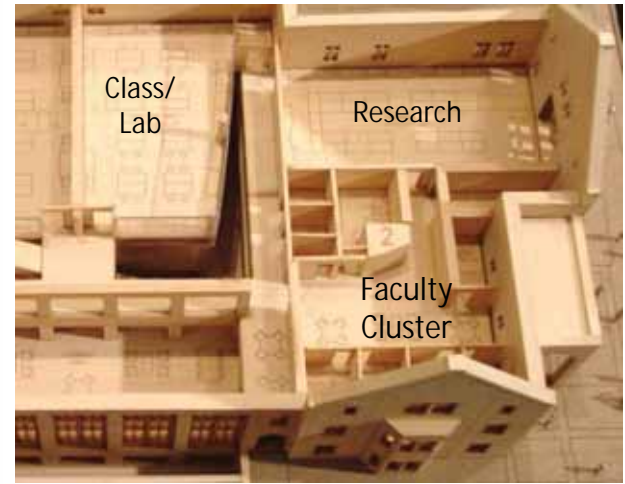
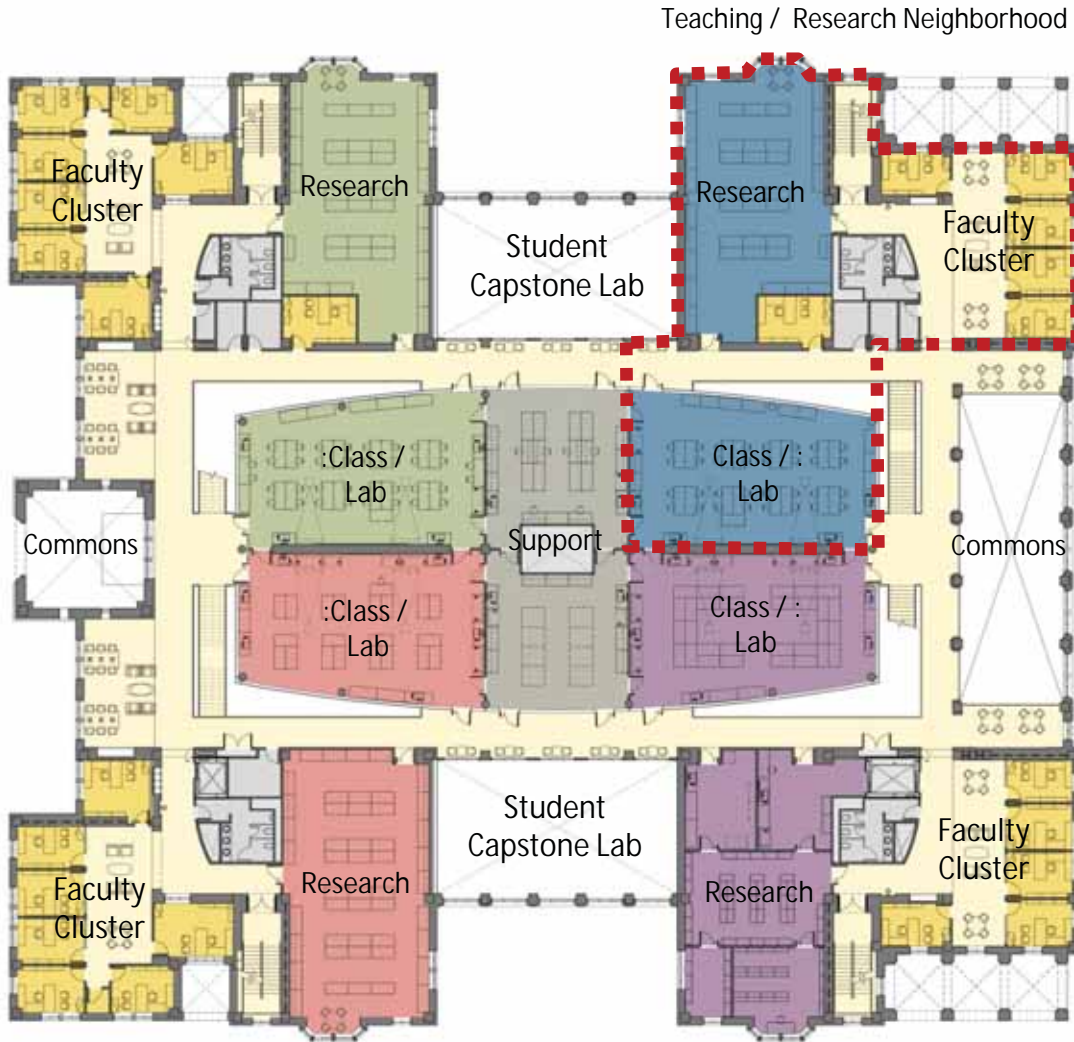
Centralized Teaching Lab Pod



Commons



# Integrated Environment: Teaching | Research Neighborhood



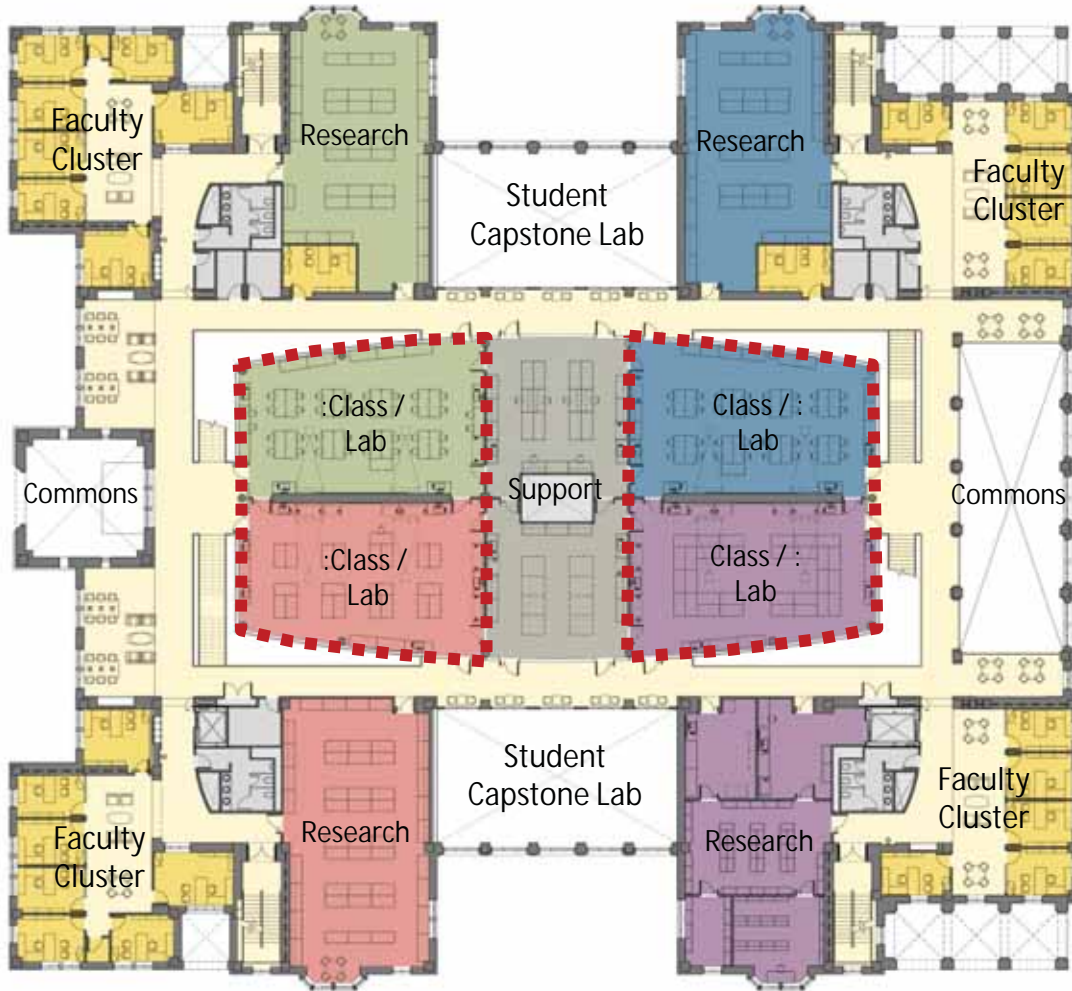
Teaching / Research Neighborhood



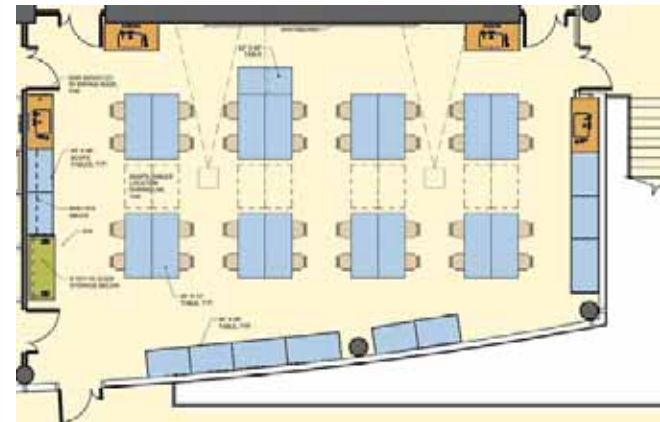
Mentoring



# Integrated Environment: Flexible Centralized Teaching Pod

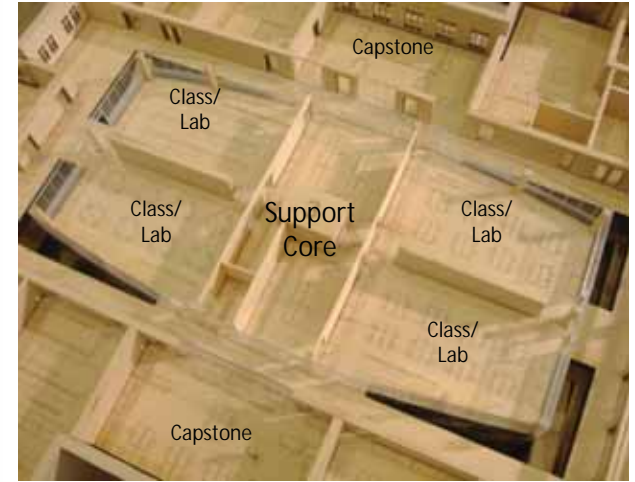
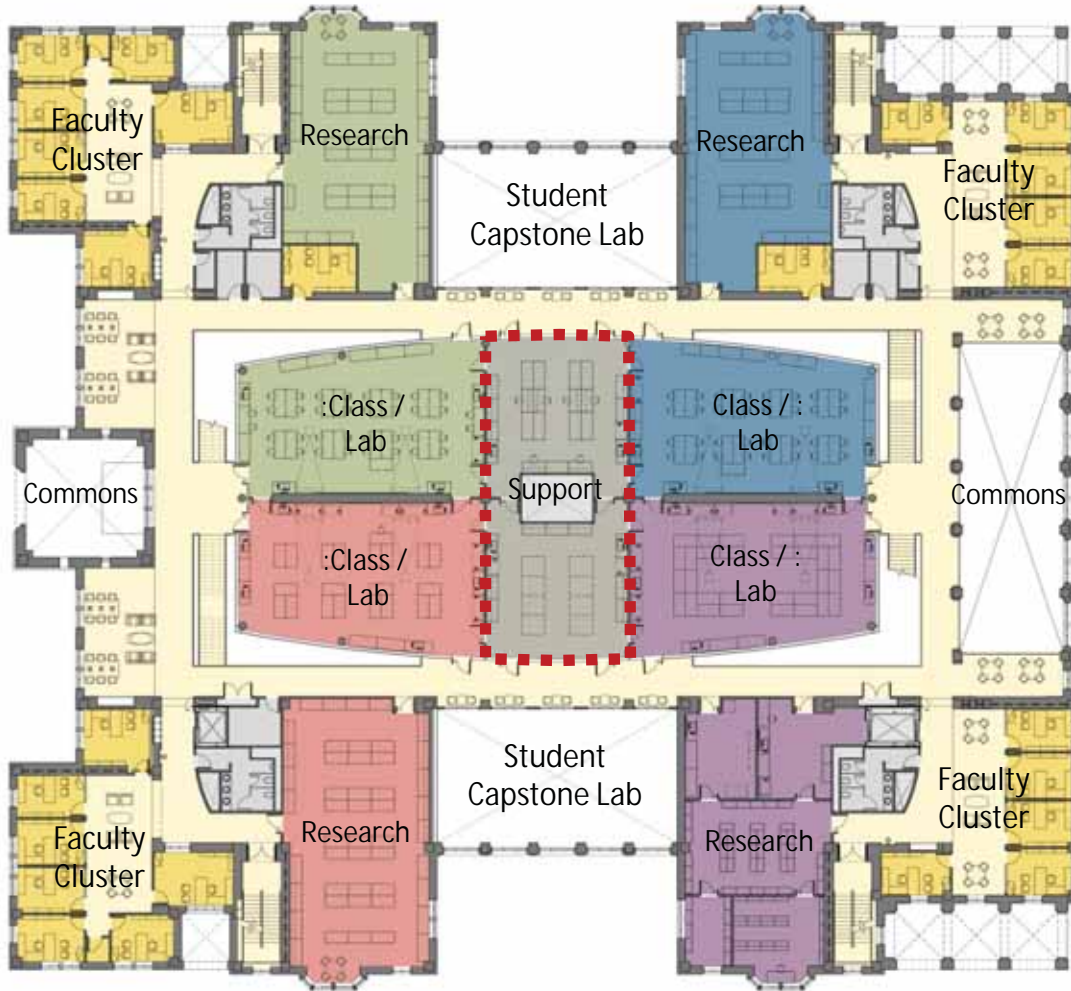


Glass Teaching Lab Pod: Activity in Sight



Combined Lab / Classroom

# Integrated Environment: Centralized Shared Support Core



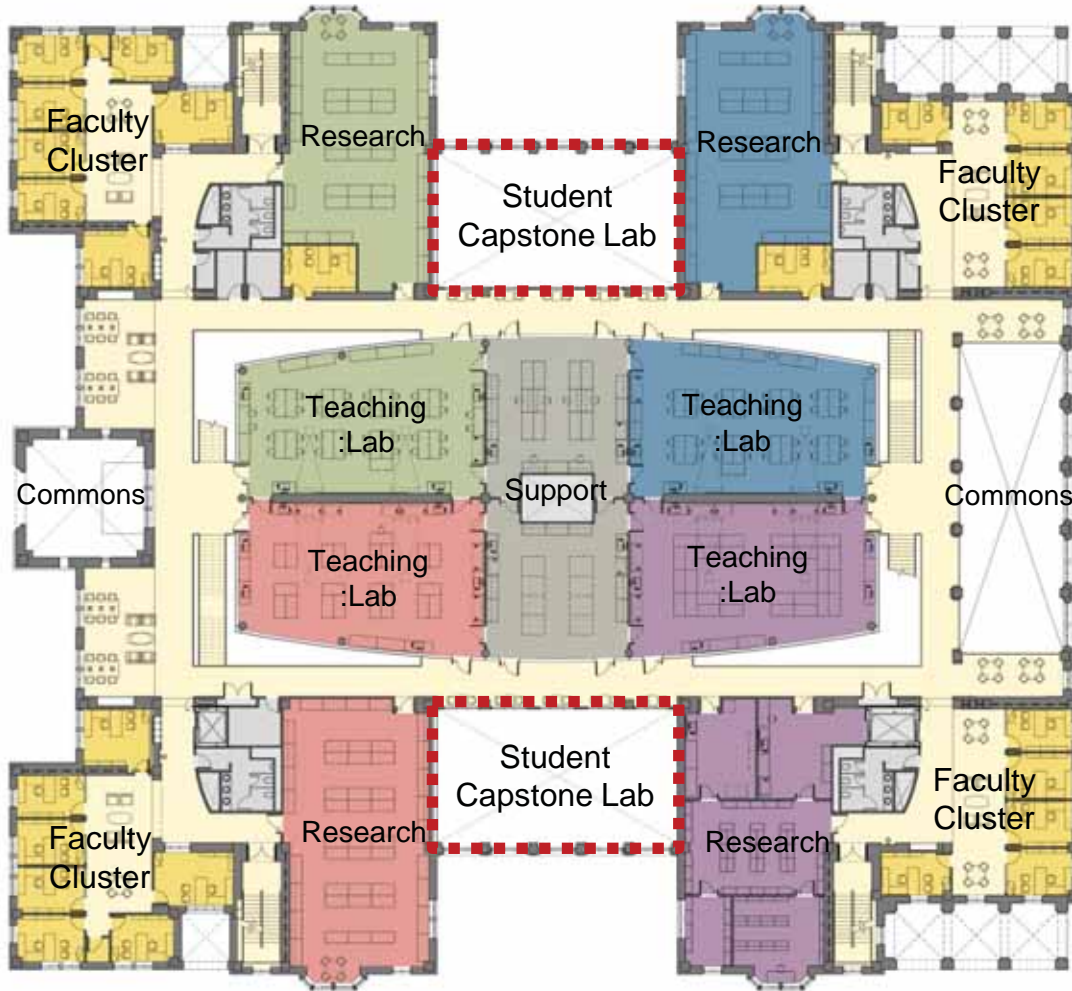
Shared Support: Teaching & Research Labs



Visual Connection to Labs & Support



# Integrated Environment: Student Capstone Lab



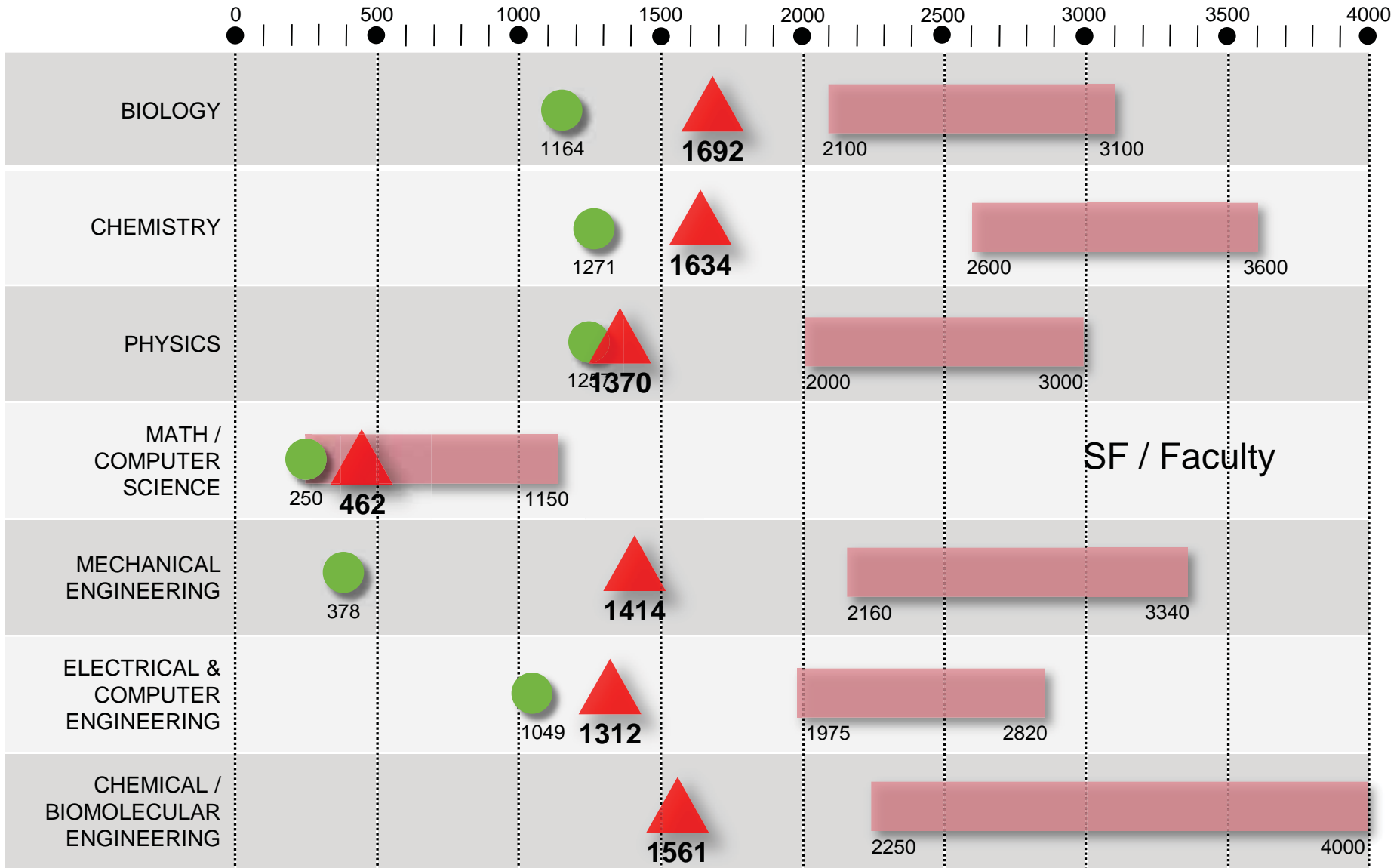
Campus Integration



Capstone Student Project Lab: Engineering



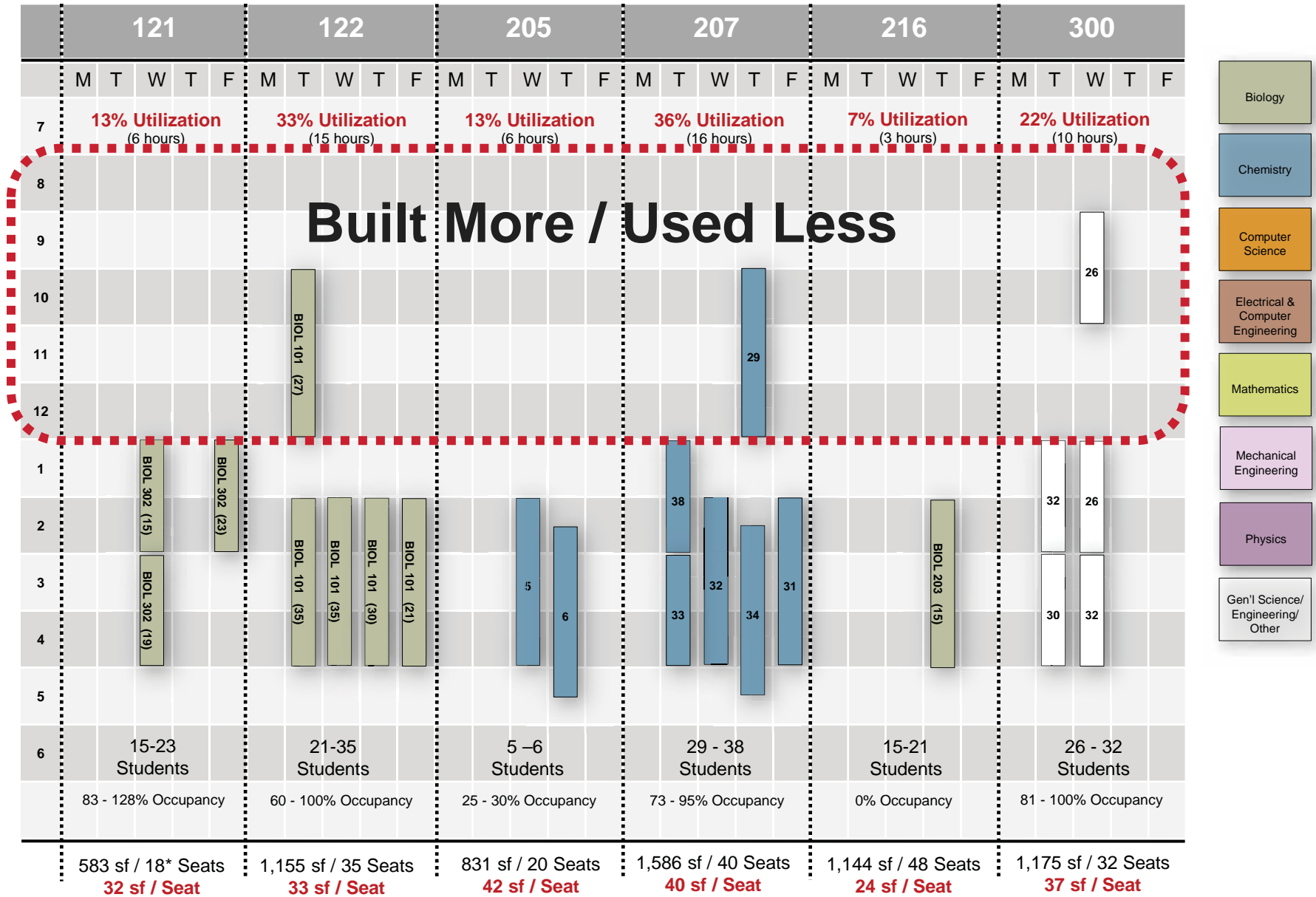
# Program Development: Consider New Benchmarking



SF / Faculty

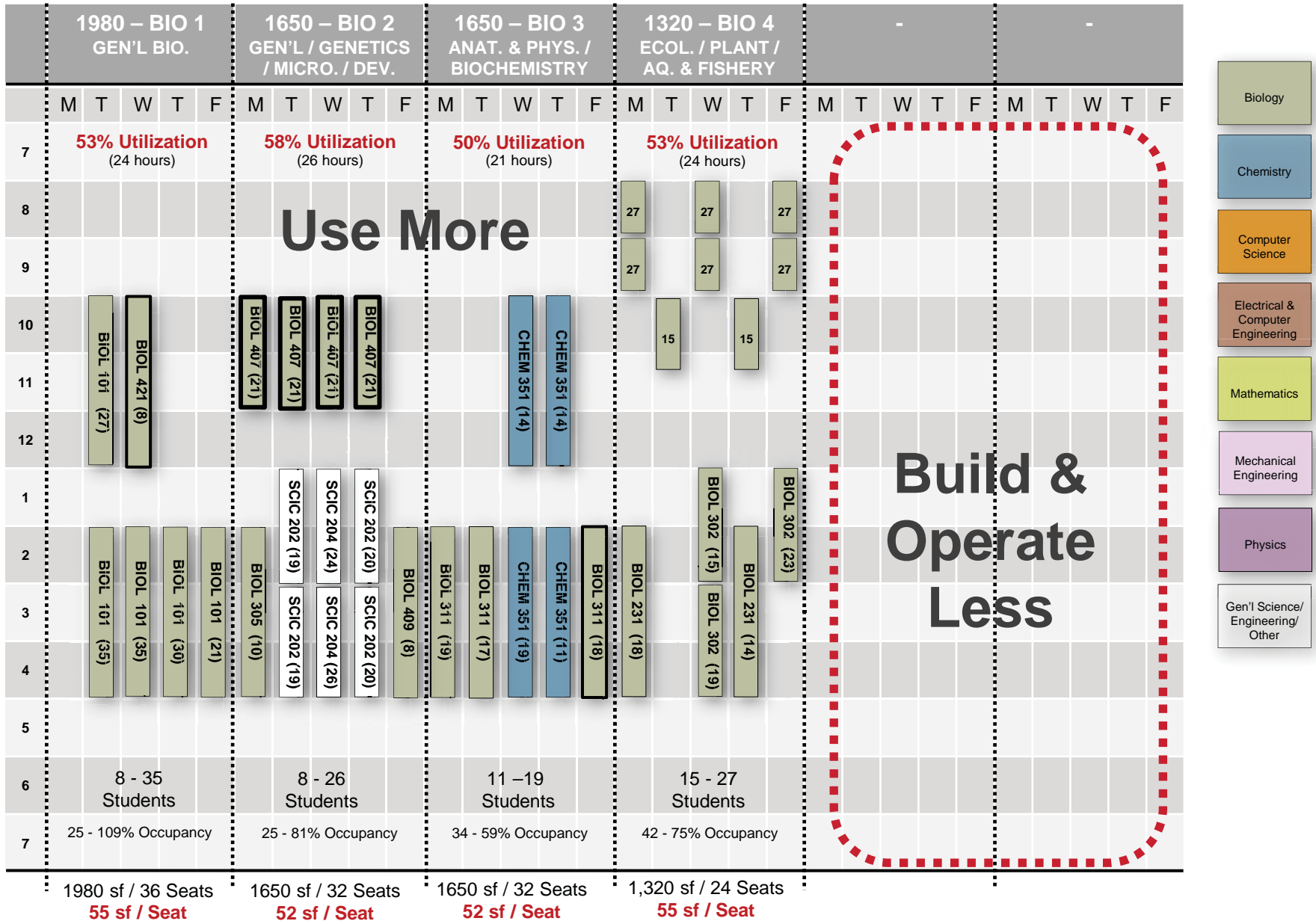
● GCC current SF/Faculty   
  Benchmarking Range   
 ▲ GCC Program

# Lab / Classroom Interchangeability: **Traditional Utilization**





# Lab Classroom Interchangeability: Increased Utilization



## Lab Flexibility and Utilization: Area Savings Comparison

	<b>Traditional Dedicated Lab Typical Utilization</b>	<b>Generic / Flexible Lab / Classroom High Utilization</b>
Utilization	<b>30% (12/40 Hours)</b>	<b>50% (20/40 Hours)</b>
Teaching Labs	<b>20 Labs / 26,400 NSF</b>	<b>12 Labs / 15,840 NSF</b>
Support Core	<b>10 Cores / 3,300 NSF</b>	<b>6 Cores / 5,940 NSF</b>
Project Labs	<b>Not Provided</b>	<b>2 Labs / 3,300 NSF</b>
<b>Total NSF</b>	<b>29,700 NSF</b>	<b>25,080 NSF</b>

**Area Reduction: 4,620 NSF**  
**16% Reduction in Area**  
**(Not Including Additional Classroom Reduction)**





- Integrating Science and Engineering In An **Undergraduate Environment:**
  - Active Science & Engineering in Sight Promotes Interdisciplinary Learning
  - Treat Research as Part of the Learning Experience
  - Organize the Facility Around “Neighborhoods” to Inspire Mentoring
  - Class / Lab Flexibility Promotes Interchangeability Between Disciplines
  - Shared Support & Dedicated Student Project Labs Maximizes Utilization
  - Re-Evaluate Benchmarks in Context of Combined Facilities





- **Context:**

- Urban **Undergraduate & Graduate** Institution: Teaching & Research
- Separate Science & Engineering Schools: Department Centric

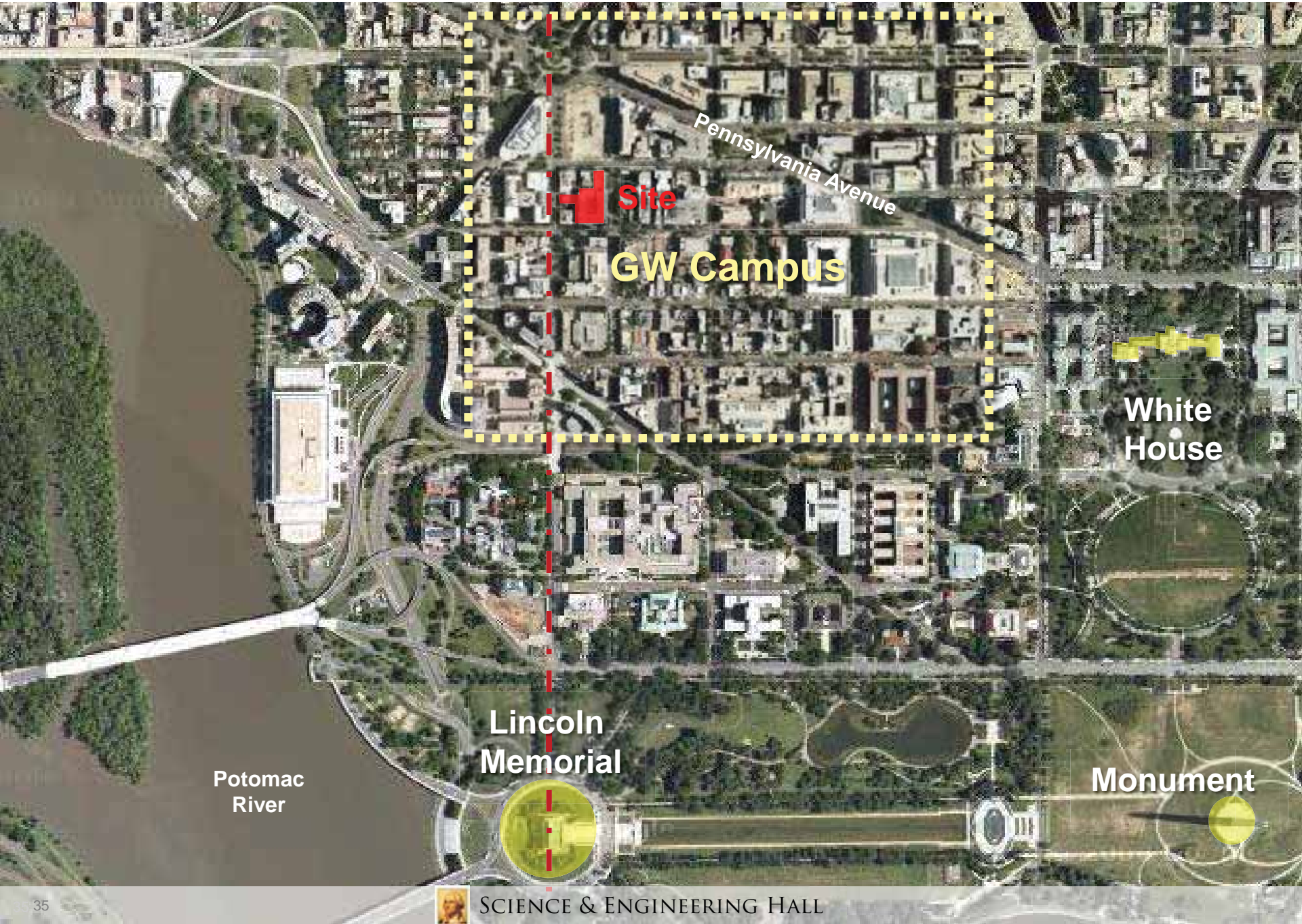
- **Future:**

- Scholarly Activity: Major Investment to Significantly Increase Research Profile
- Consolidate Science & Engineering Into Single Facility: Synergies & Efficiencies
- Highly Interdisciplinary & Collaborative Environment
- Highly Flexible Environments to Adapt to Changing Teaching / Research
- Learning: Focus on Small Lab / Class Environments
- Regional Hub for Science & Engineering @ Heart of Nations Capitol

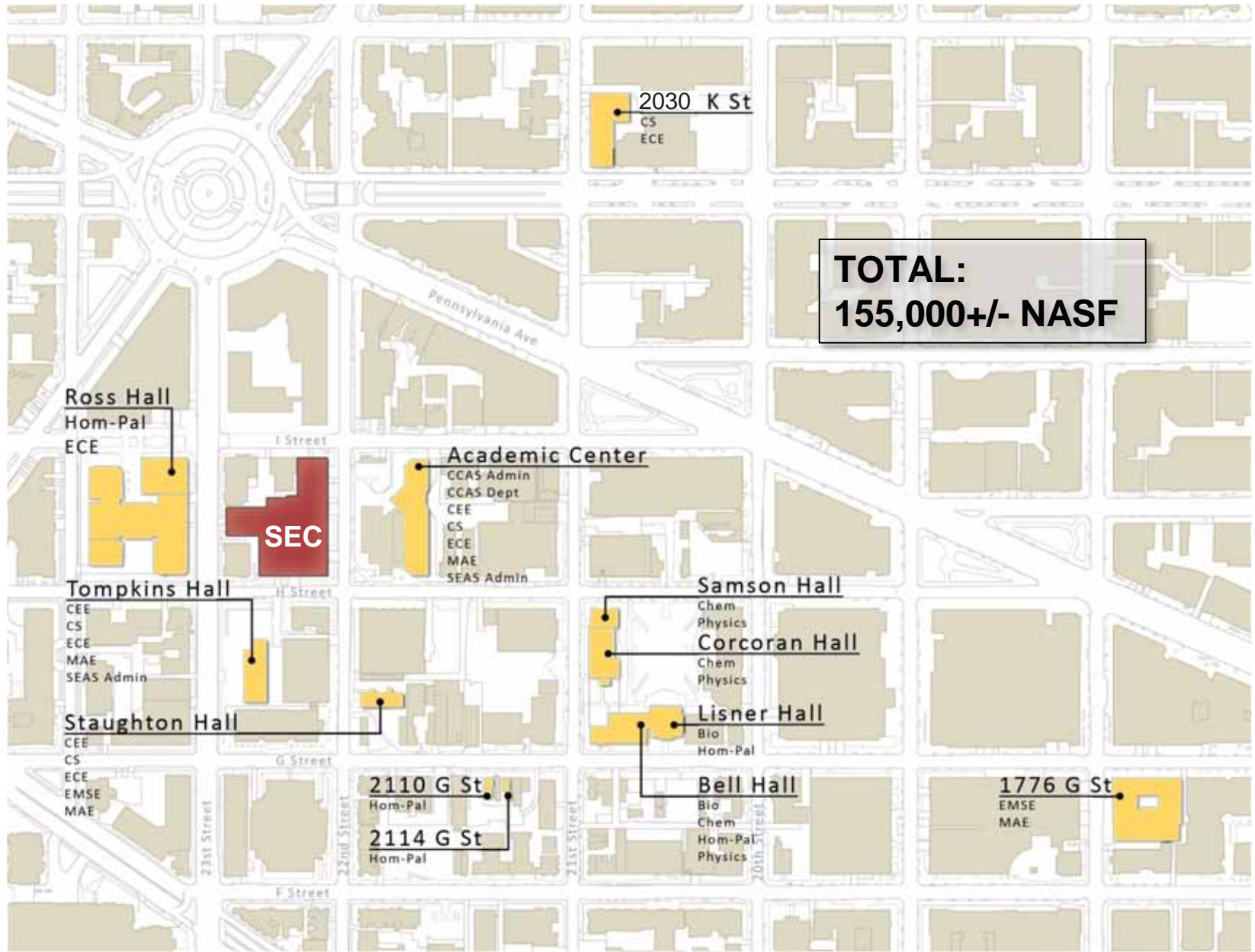




# Context

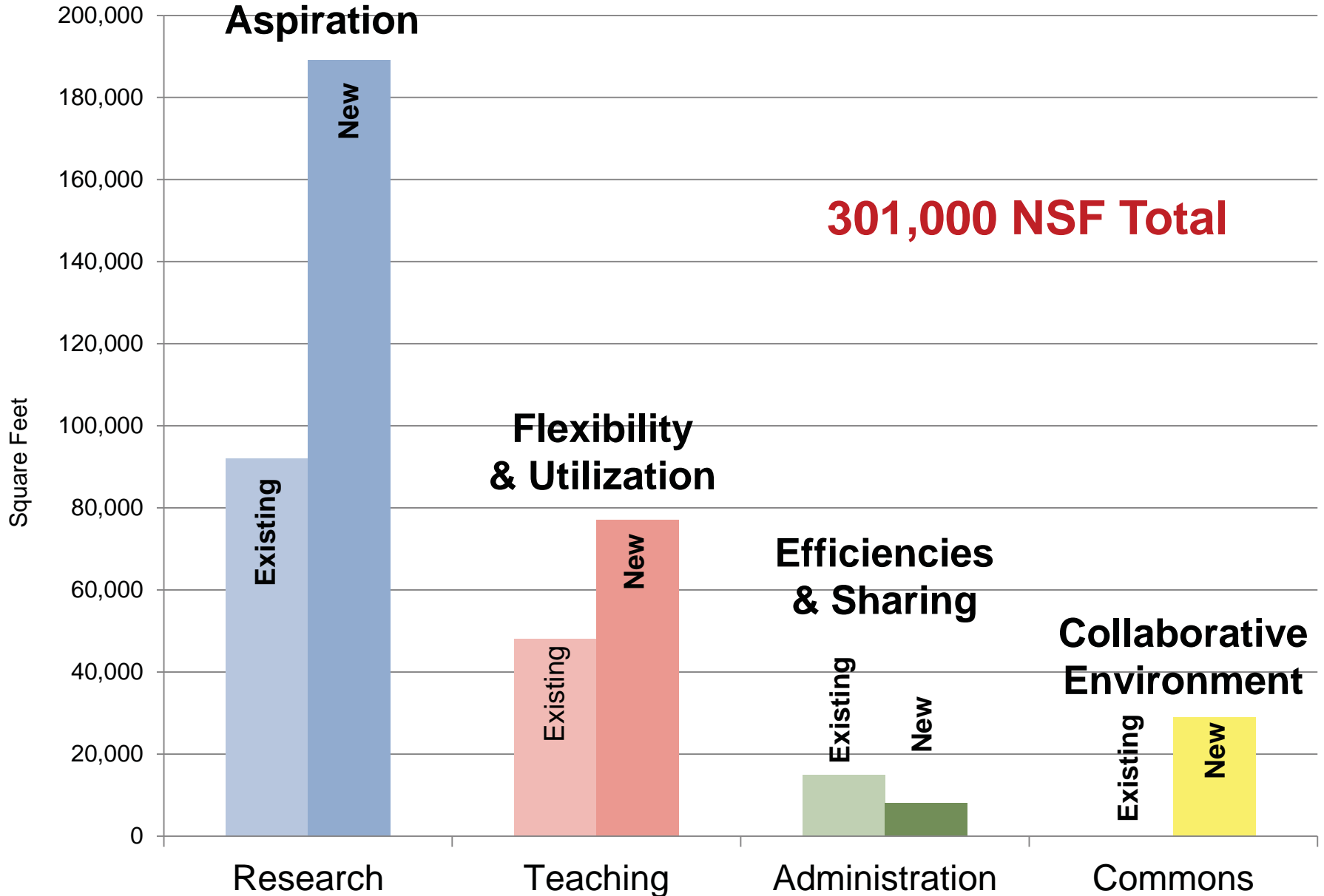


# Current Science & Engineering Building Locations

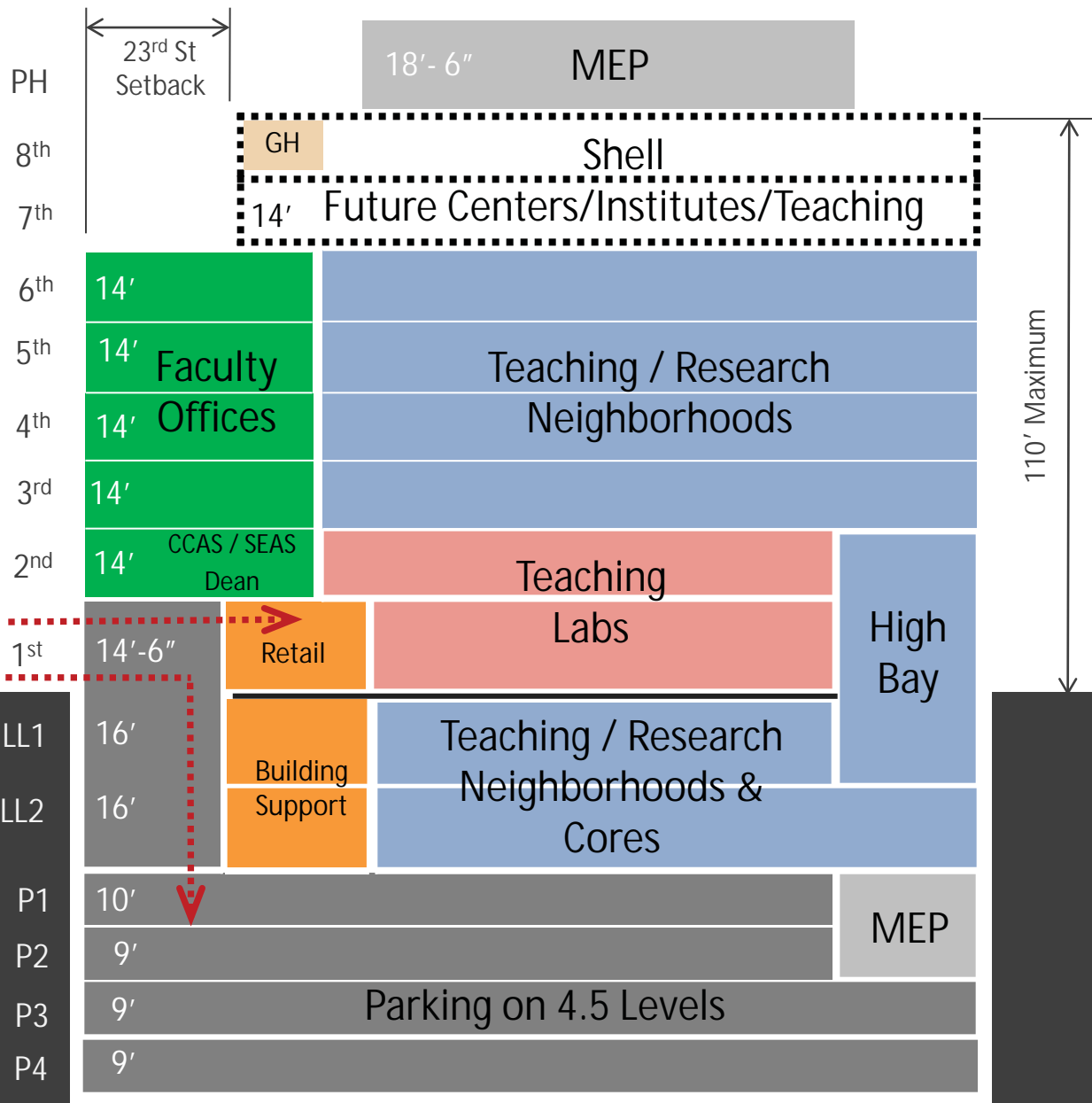




# Program Allocation: Comparison of Existing to New



# Building Section





# Teaching / Research Neighborhood Floor

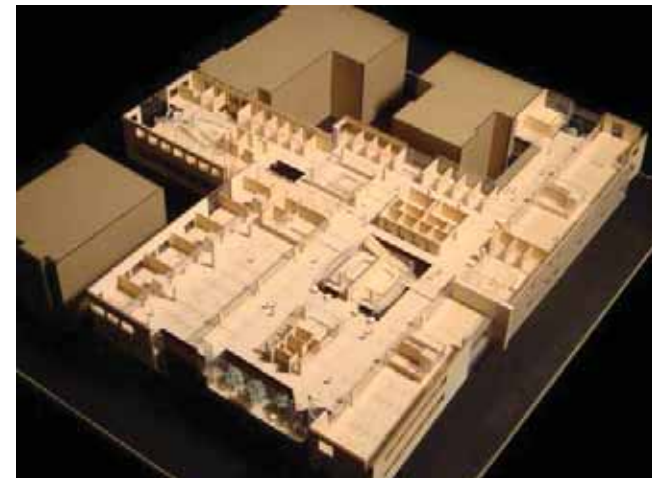


Typical Floor: 2-8

50,000 sf Floor Plate



Teaching Lab Environment



Concept Model



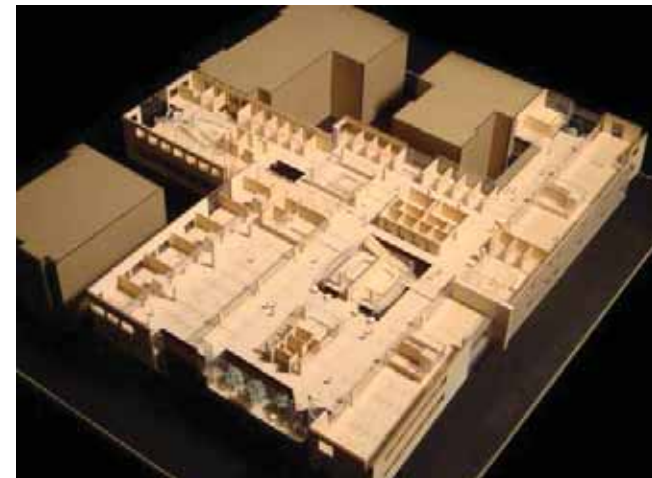
# Teaching / Research Neighborhoods: **Public Zone**



Typical Floor: 2-8



Teaching Lab Environment



Concept Model





# Teaching / Research Neighborhoods: Office Suites

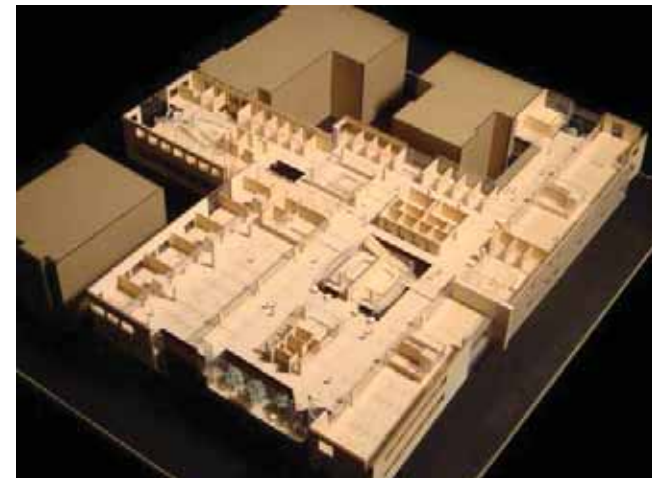


Typical Floor: 2-8

3 Office Suites / Floor



Teaching Lab Environment



Concept Model



# Teaching / Research Neighborhoods: Teaching Labs

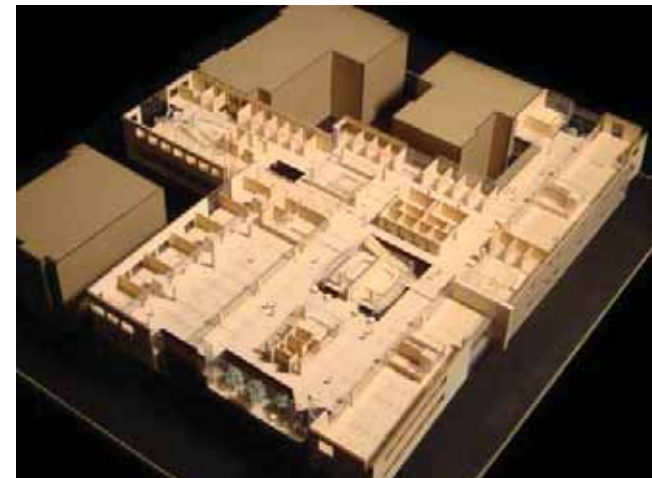


Typical Floor: 2-8

6 Teaching Labs / Floor



Teaching Lab Environment



Concept Model





# Teaching / Research Neighborhoods: Research Neighborhoods



Typical Floor: 2-8

3 Research Neighborhoods / Floor



Teaching Lab Environment



Concept Model

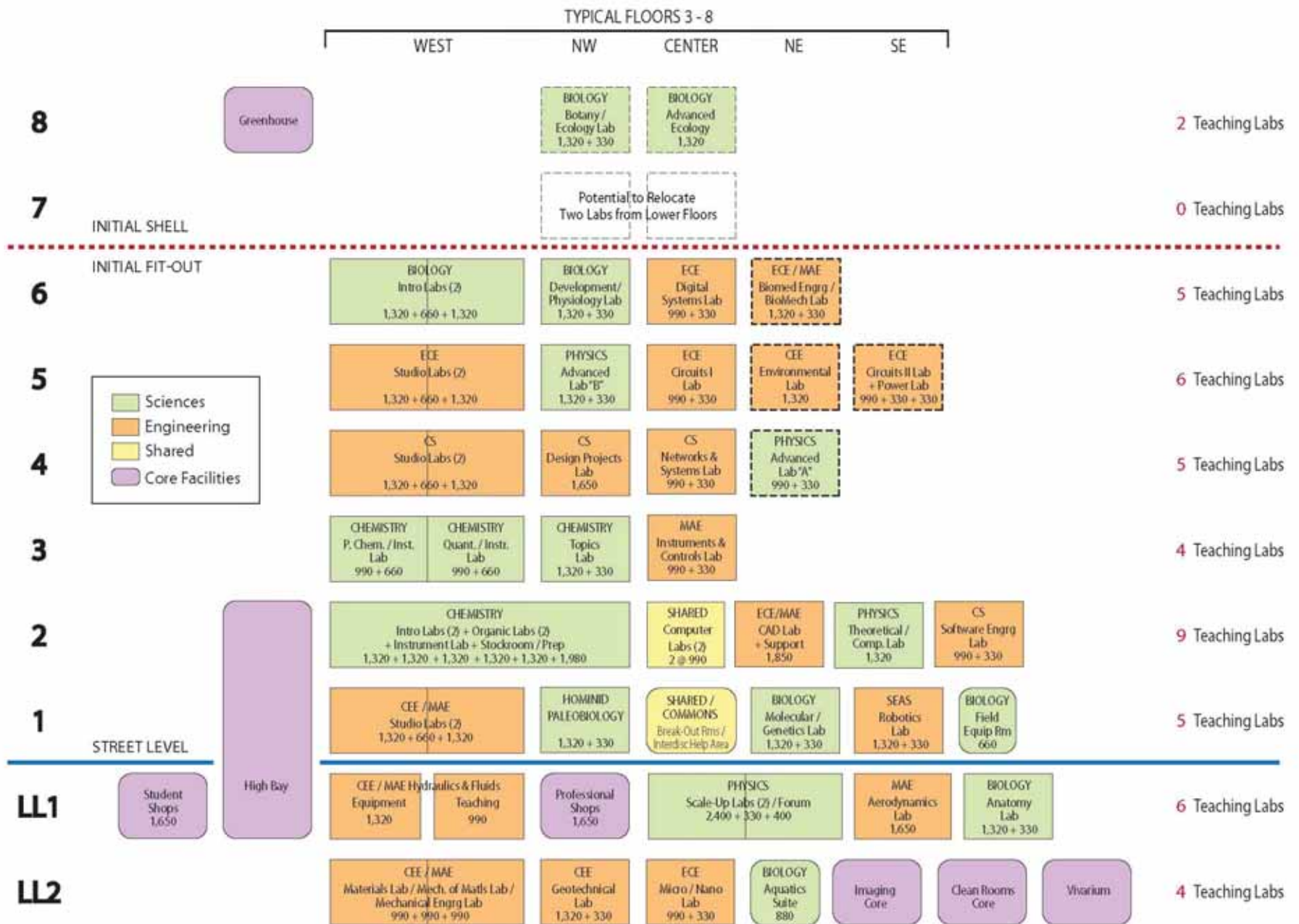




# Internal Teaching Lab Tower: Interdisciplinary Mix of Science & Engineering

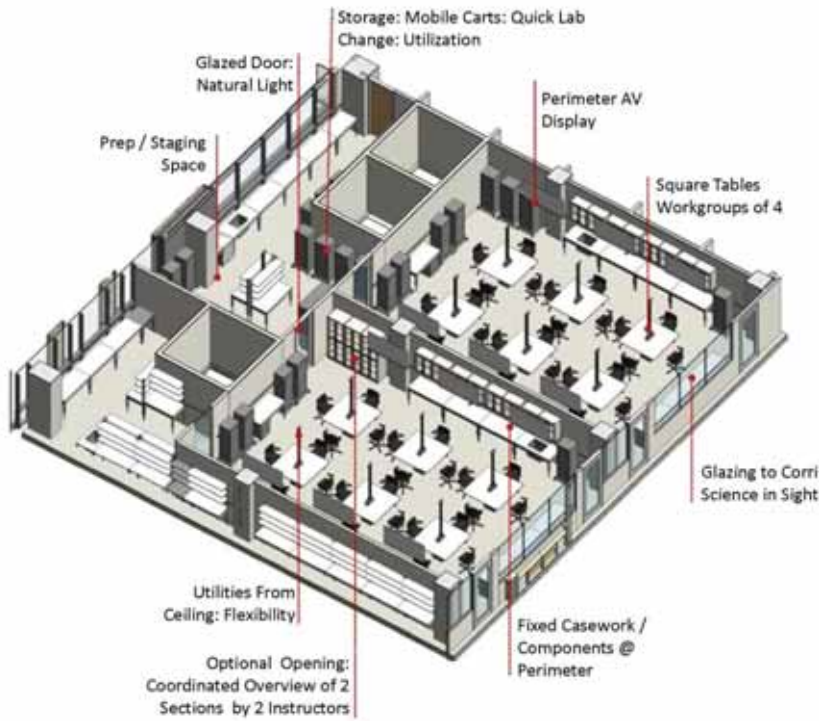


# Teaching Lab Stacking Diagram: Interdisciplinary Mix

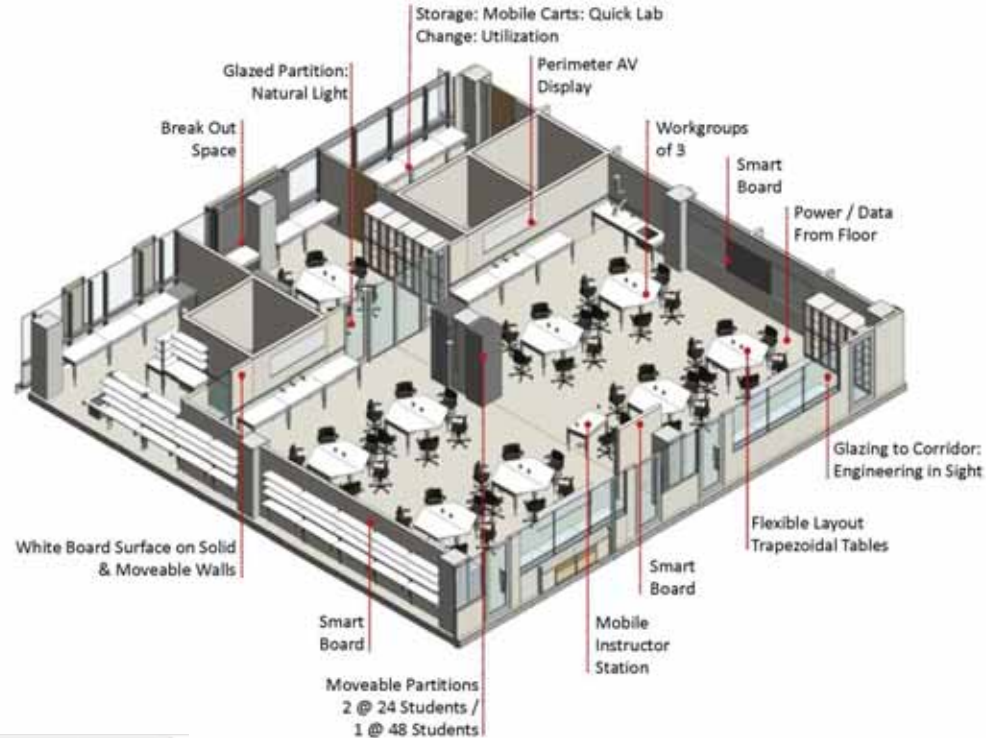




## Sciences



## Engineering



### Biology Introductory Labs

- 2 @ 1320 NSF
- 24 Students Each
- 55 sf / Student



### Computer Science & Electrical Studio Labs

- 2 @ 1320 NSF
- 24 Students Each
- 55 sf / Student



# Teaching / Research Neighborhoods: Teaching Labs

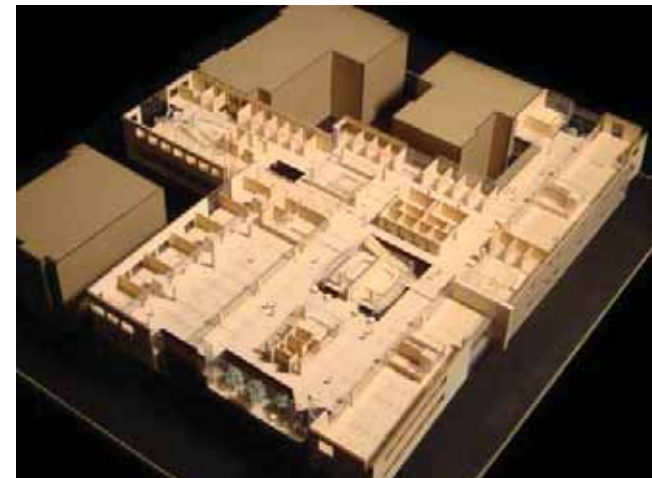


Typical Floor: 2-8

6 Teaching Labs / Floor



Teaching Lab Environment



Concept Model





# Teaching / Research Interchangeability

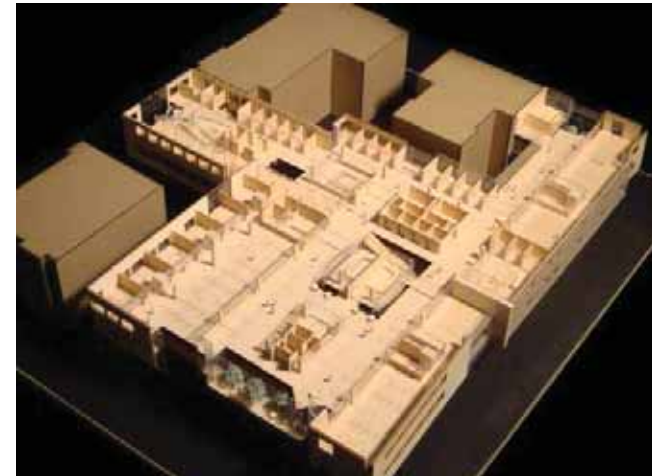


Typical Floor: 2-8

2 Teaching Labs / Floor



Research Lab Environment



Concept Model



# Collaborative & Interdisciplinary Research Environment: Open & Transparent



Open Workstations/ Transparent Lab Walls



Collaboratorium Vertically Connects Neighborhoods

Collaboratoriums  
Influences Exterior  
Character



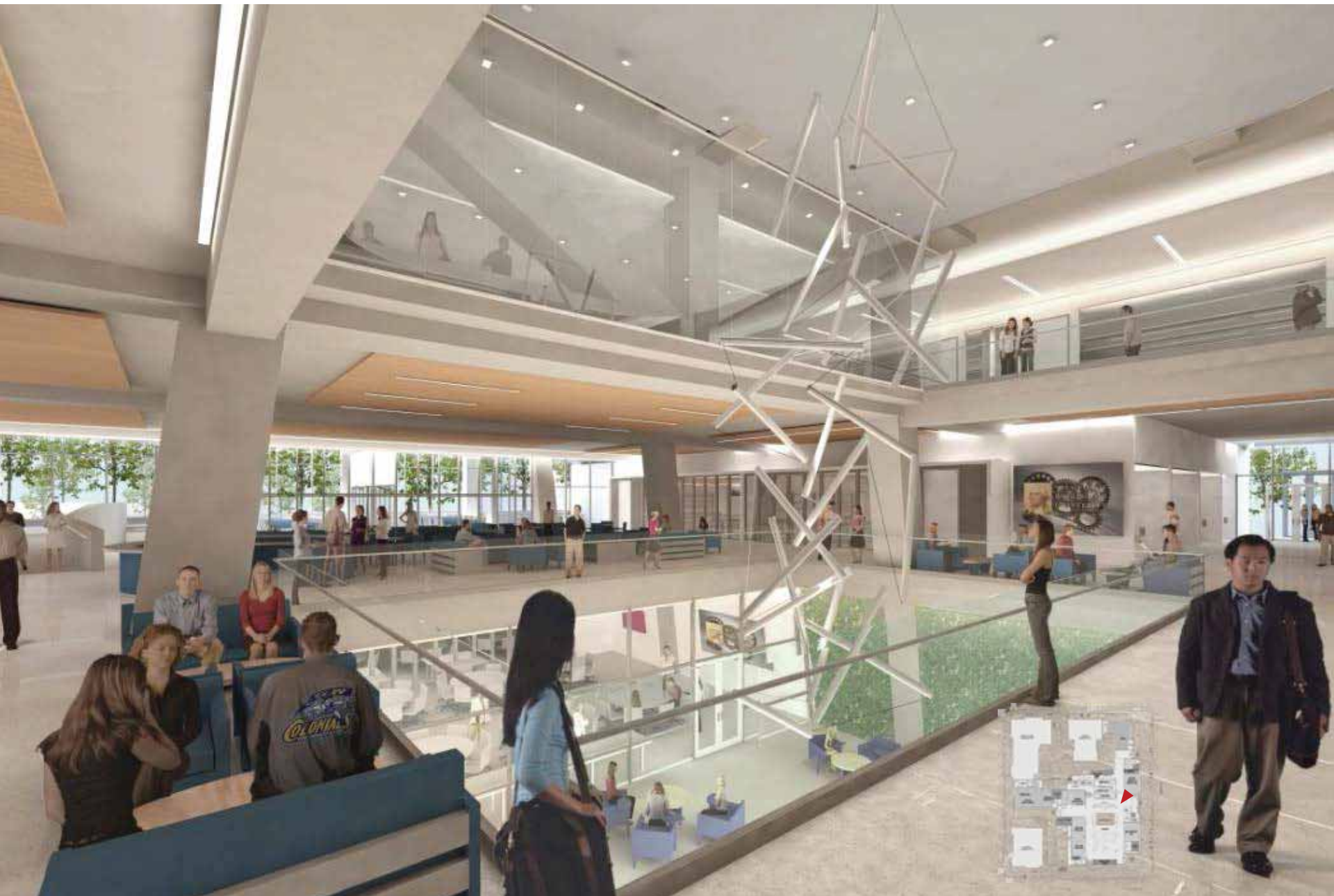
SCIENCE & ENGINEERING HALL







# Public Commons: Expressive of Science & Engineering





# Multi-Purpose Space Flexibility



Lower Level 1



Lower Level Commons



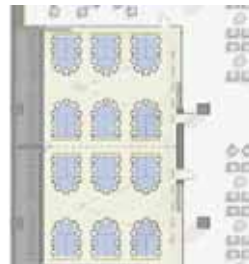
Physics Scale Up- Lab



# Multipurpose Space Flexibility: Scale-Up Lab



108 Students





# Multipurpose Space Flexibility: Symposium



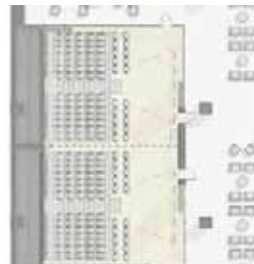
72 Seats



# Multipurpose Space Flexibility: Auditorium / Lecture



208 Seats





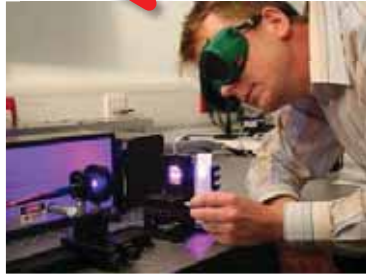
# Shared Core Facilities

## Engineering

- Motion Capture
- Thin Film Vapor Deposition



- Laser
- Wind Tunnel
- High Bay
- Clean Room/Nano
- Machine Shop



## Sciences

- SEM / TEM
- Mass Spectrometry/ Proteomics
- NMR / MRI
- X-Ray Diffraction
- Vivarium
- DNA Microarray
- Bioinformatics



← SHARED →



# Core Integral to the Public Domain



## High Bay: Research & Teaching







- **Integrating Science & Engineering: Undergraduate / Graduate Environment:**
  - Planning & Infrastructure Flexibility: Program & Space Type Adaptability
  - Multi-Discipline Floors : Interdisciplinarity / Departmental Identity
  - Range of Core Requirements: Planning & Environmental Constraints
  - Open & Transparent Environment: Cultural Transformation
  - Integration of Teaching & Research: Public Domain vs. Security
  - Creating an “Experience” That Promotes a Campus / Regional Hub







# Wisconsin Institutes for Discovery: Aspirational Drivers

- **Context:**

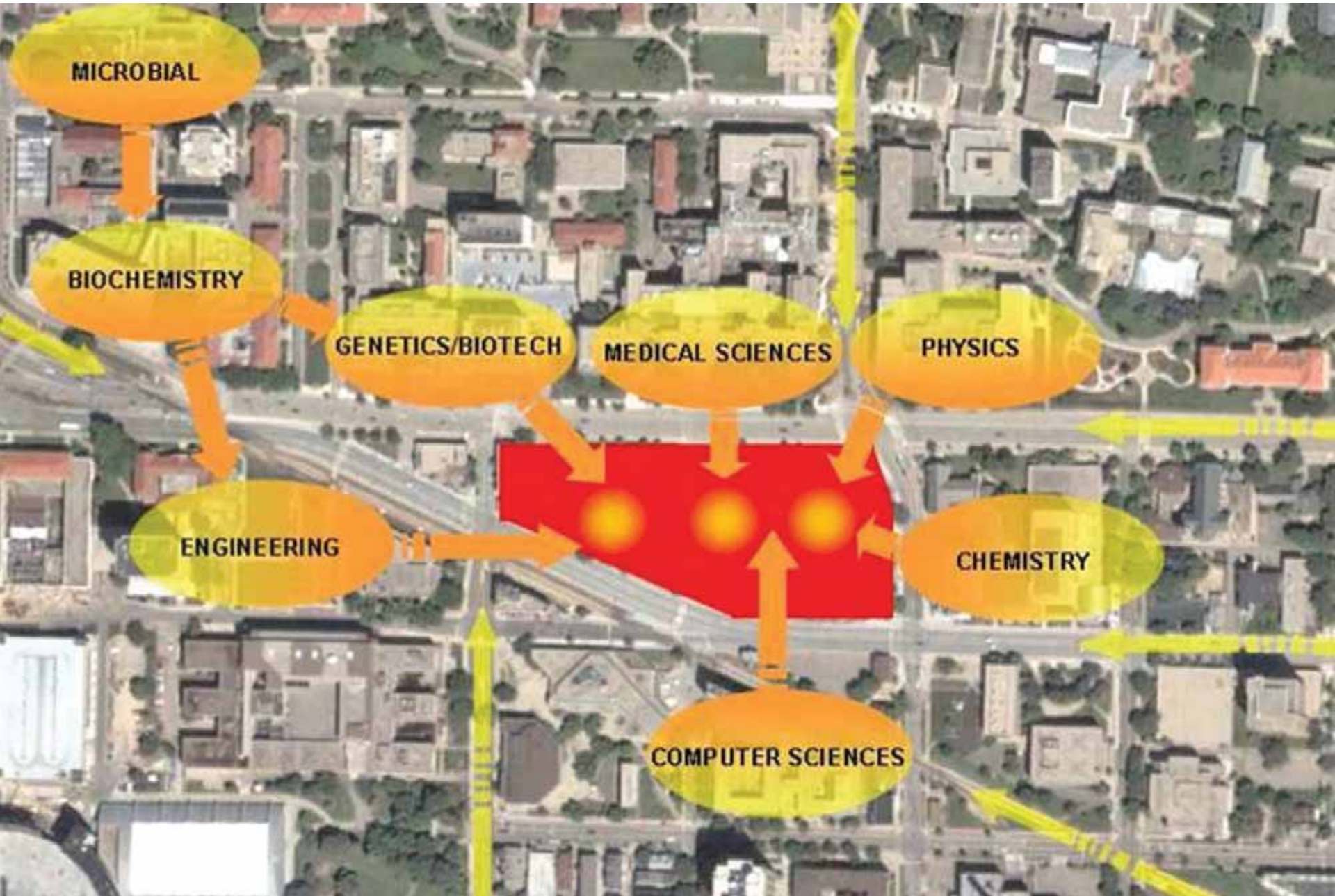
- Robust Research University / *Graduate and Post-Graduate*

- **Future**

- Interdisciplinary Research Neighborhoods
- Highest Attributes of Collaboration: Proposals for Space
- Public / Private Partnerships: Paralleling Industry
- Continuum from Discovery to Commercialization
- Town Center for Campus and Community: Research / Teaching Outreach

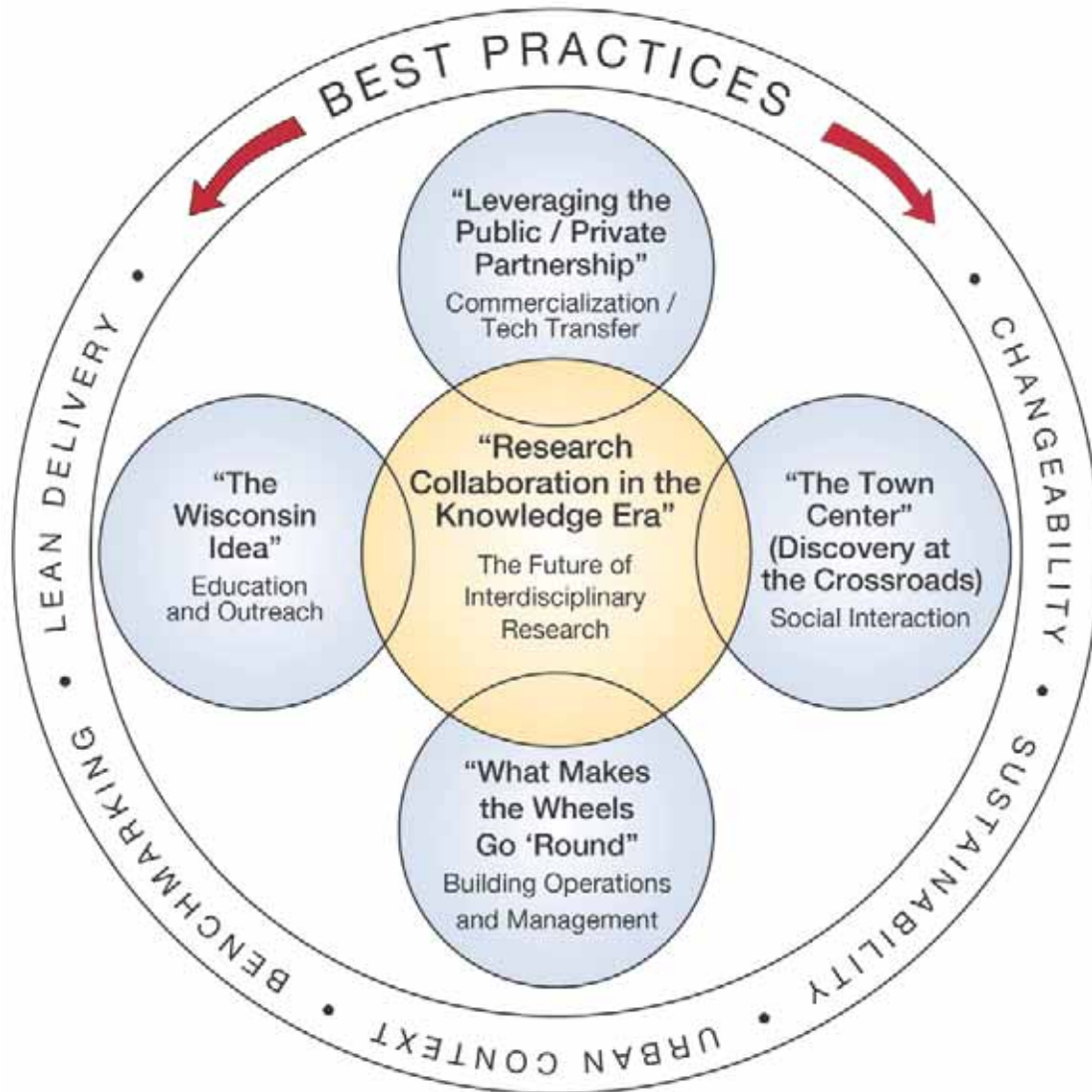


# A Unique Vision & Opportunity





# Integrated Science & Engineering Hub





# Community / Interaction-Based Collaboration



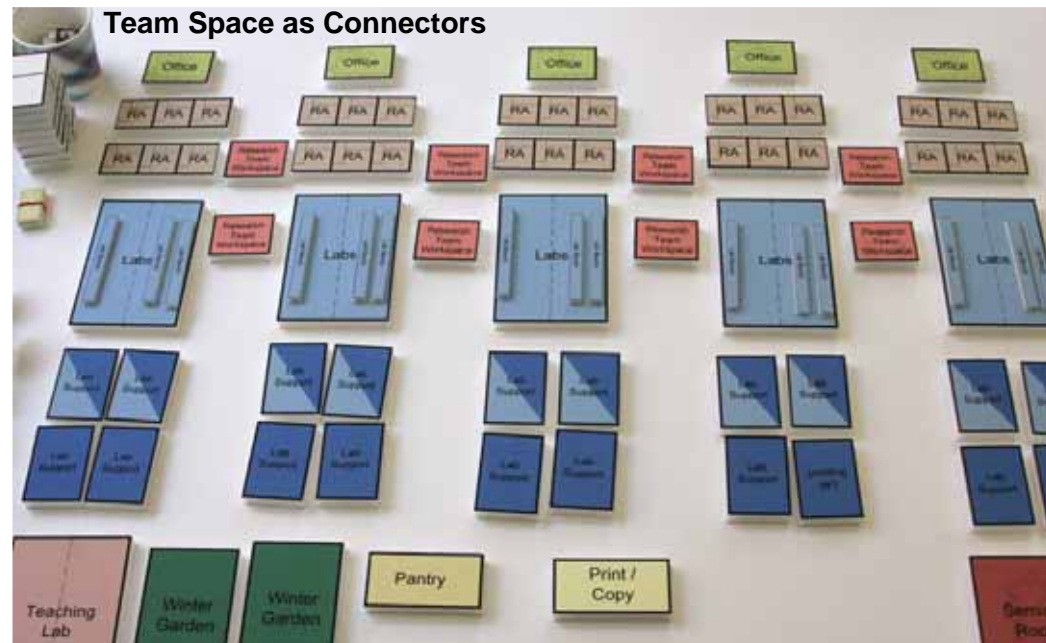
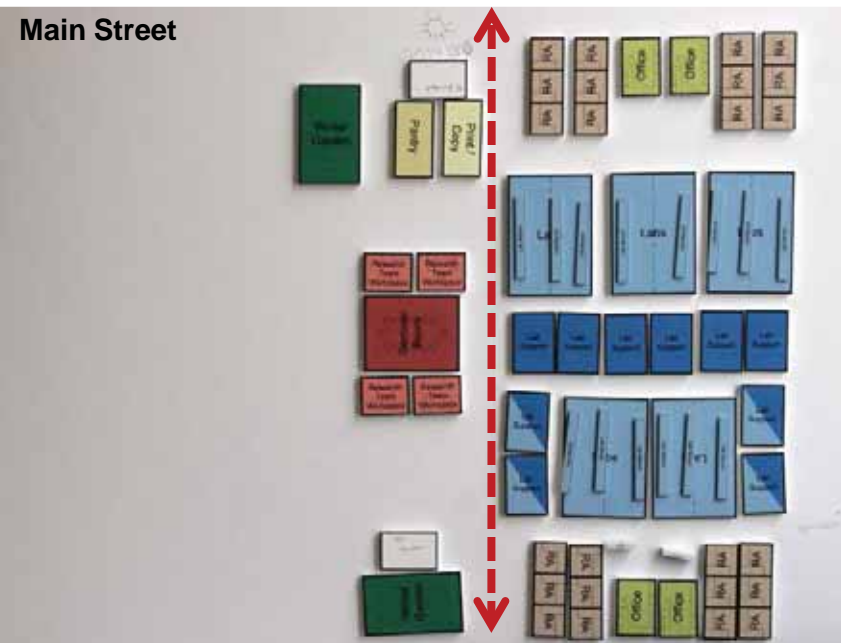
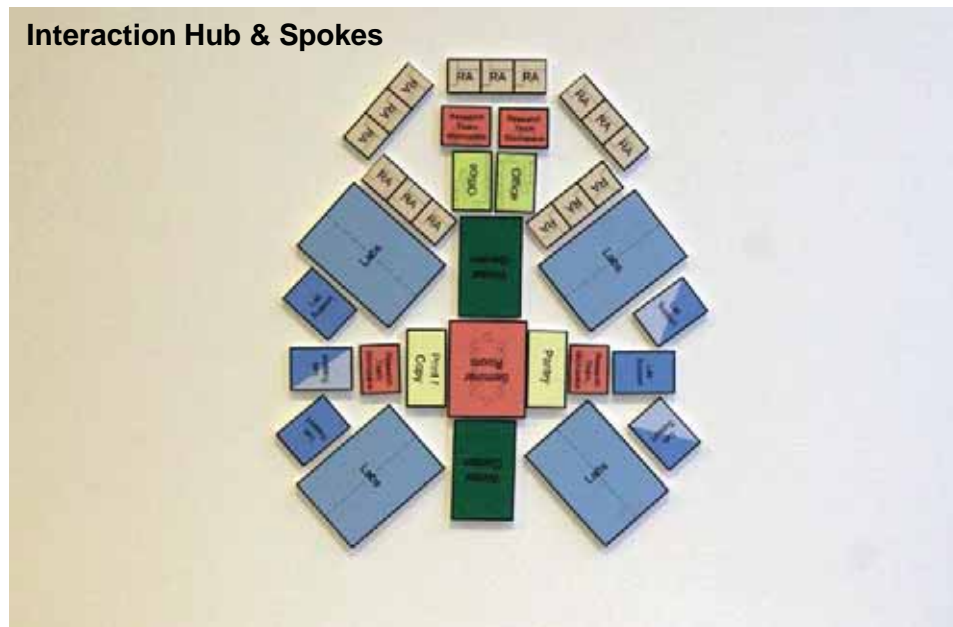
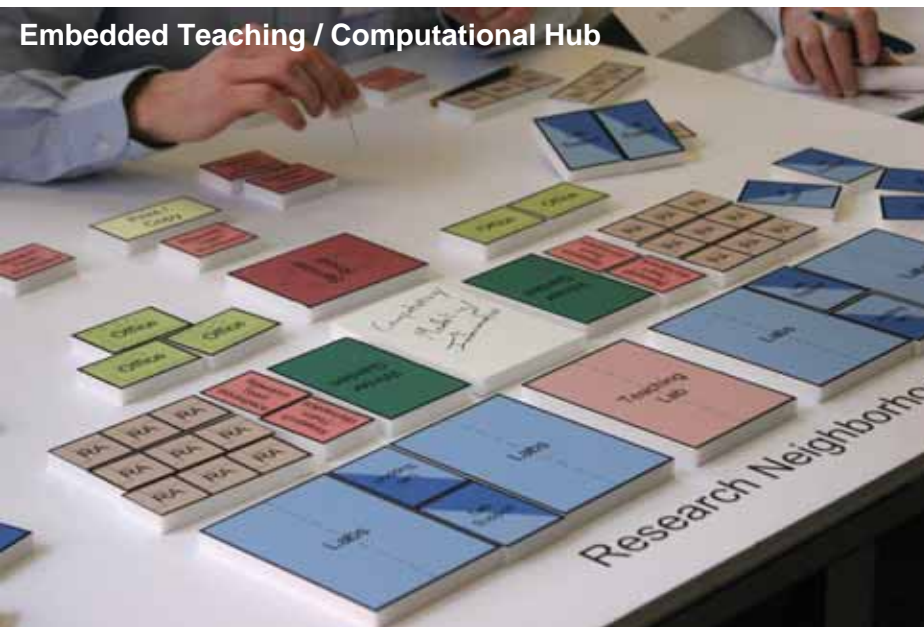
Section: Visually Interconnected Communities

Yes	?	No			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Placemaking</b>		<b>20 Points</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1	<b>Thick space:</b> Power of Ten (PPS), triangulation, layering of uses	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2	<b>Affordances:</b> Sittable space	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 3	<b>Affordances:</b> Surfaces for resting or setting something down	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 4	<b>Visual Respite:</b> Fascination	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 5	<b>Prospect / Refuge:</b> "Enclosure" with long-distance views	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 6	<b>Affordances:</b> Plentiful & accessible electrical outlets in public spaces	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Flow</b>		<b>20 Points</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1	<b>Crossroads:</b> Sittable space where paths cross	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2	<b>Draws:</b> Food, coffee, copy, restrooms, office support person's workstation	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 3	<b>Streams &amp; Eddies:</b> Room for circulation and incidental interaction	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 4	<b>Desire Lines:</b> Reinforce natural paths to surrounding destinations	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 5	<b>Central Focus:</b> Something in the center of an open space	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 6	<b>Communicating Stairs</b>	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Perceptual Access</b>		<b>15 Points</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1	<b>Transparency:</b> Controllable by individuals, accessible	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2	<b>Wayfinding:</b> Imageability of layout, paths, edges, nodes, districts, landmarks	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 3	<b>Sight Lines:</b> Approaching building / in building	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 4	<b>Wayfinding:</b> Legibility of structure; at functional center for regional users	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Territoriality</b>		<b>10 Points</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1	<b>Shared Space:</b> Everyone's land vs. no man's land	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2	<b>Defensible Space:</b> Can be visibly "owned" and delineated	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 3	<b>Front and Backyards:</b> "Front yards" for bridging, "back yards" for bonding	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 4	<b>Jurisdiction:</b> Ensure it is temporary / not colonize-able / flexible	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Spatial Relations</b>		<b>10 Points</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1	<b>Proxemics:</b> Range of comfortable social distances / gradients of privacy	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2	<b>Tropism:</b> Vary lighting and motion	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 3	<b>Low Building Height:</b> Accessibility & views between floors	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 4	<b>70' Horizontal Distance:</b> Maximum between communicators	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Biophilia</b>		<b>5 Points</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1	<b>See and Be Seen</b>	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2	<b>Shill Effect</b>	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 3	<b>Comfortable Density</b>	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>Project Totals (Pre-Certification Estimates)</b>		<b>80 Points</b>

Project Checklist

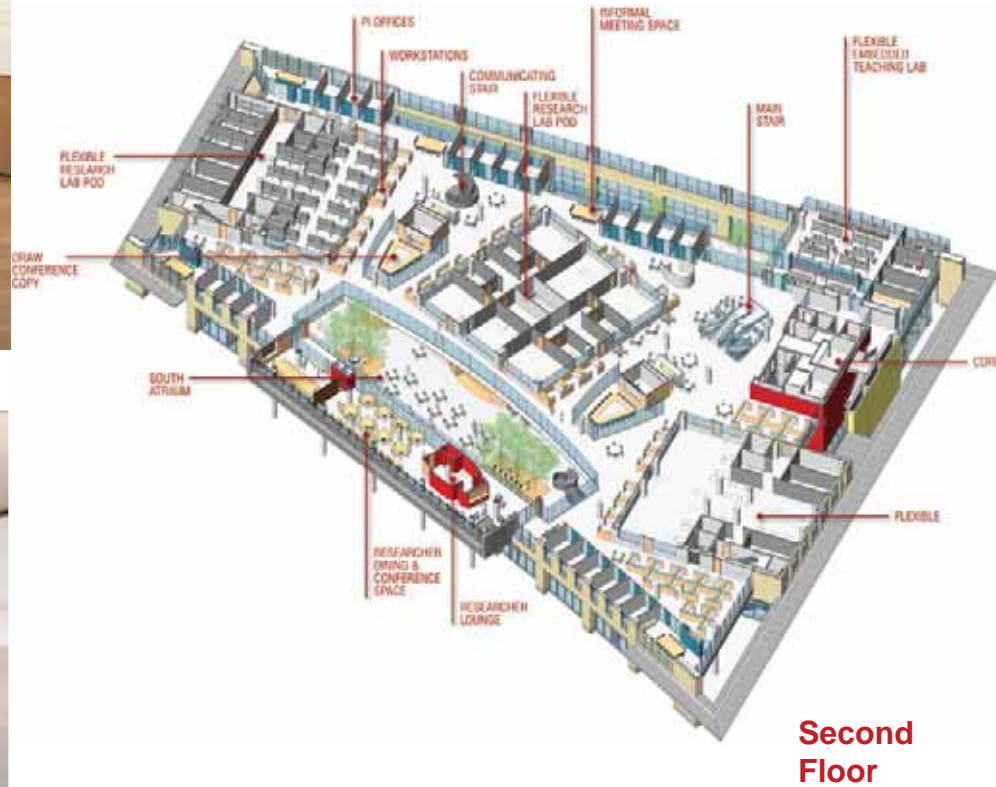


# Interdisciplinary Science & Engineering: Adjacency Models





# Community Building without Corridors



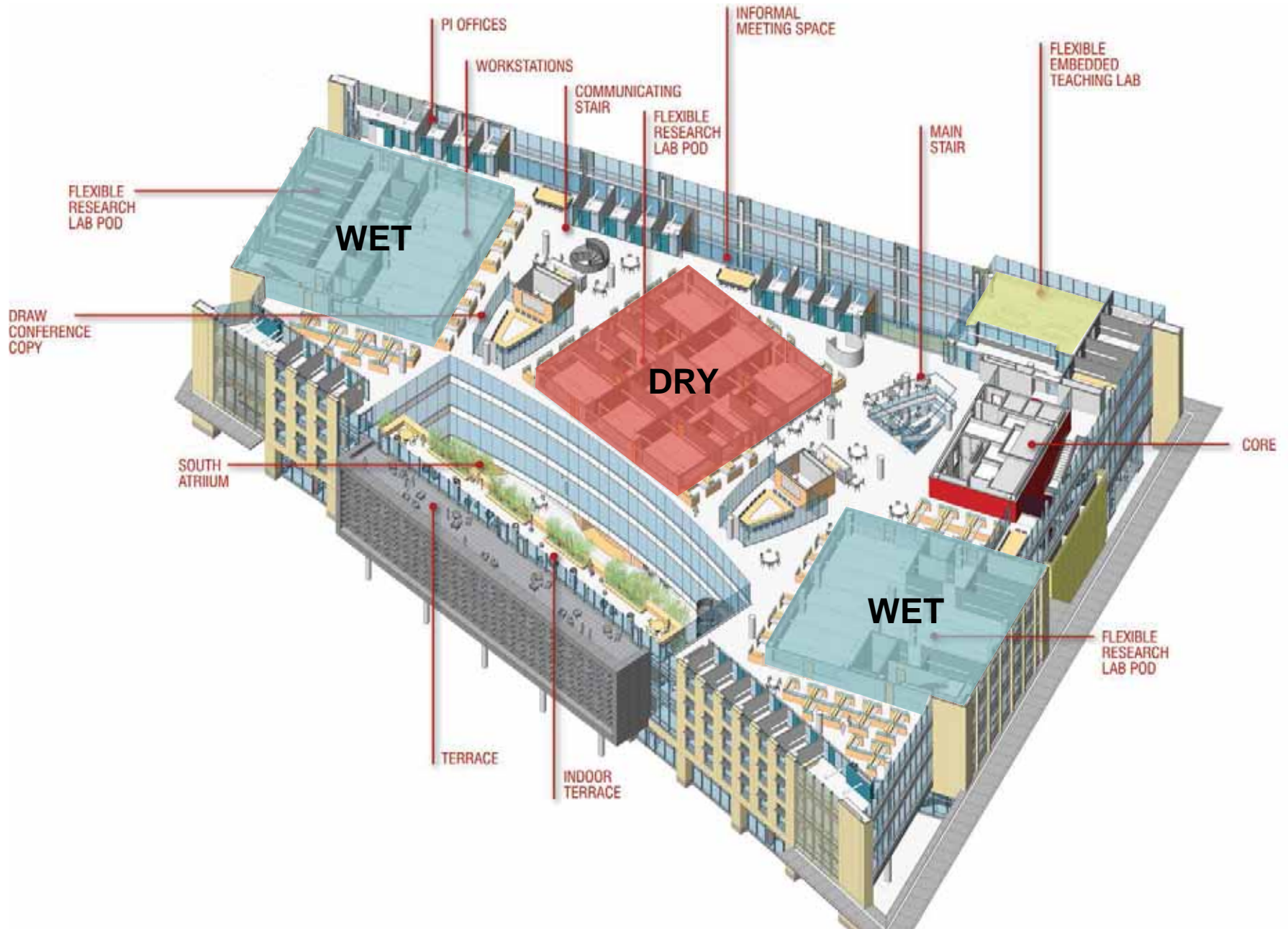
# Collaborative Environment





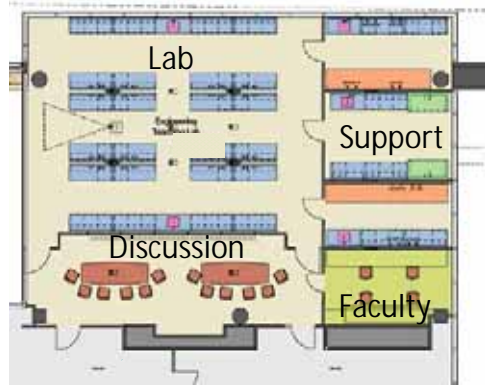


# Flexible Research Pods: Computational Hub



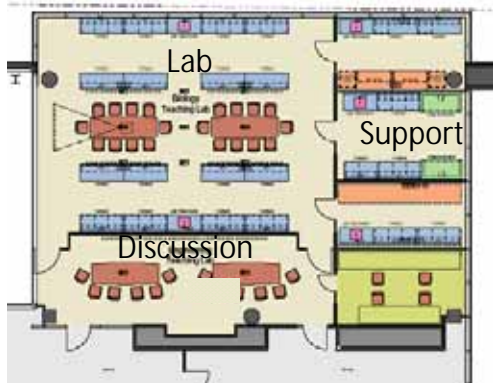


# Teaching / Research Interchangeability: **Flexible** Embedded Teaching Labs

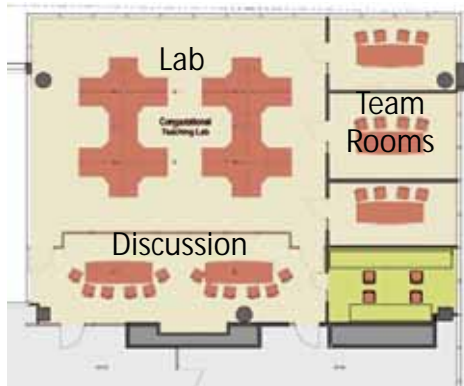


**Engineering**

- Casework: Moveable / Height Adjustable
- Tables: Moveable / Height Adjustable
- Chairs: Height Adjustable
- Utility Distribution: CIP / Floor Boxes
- Technology: Multiple Screens / Wired & Wireless



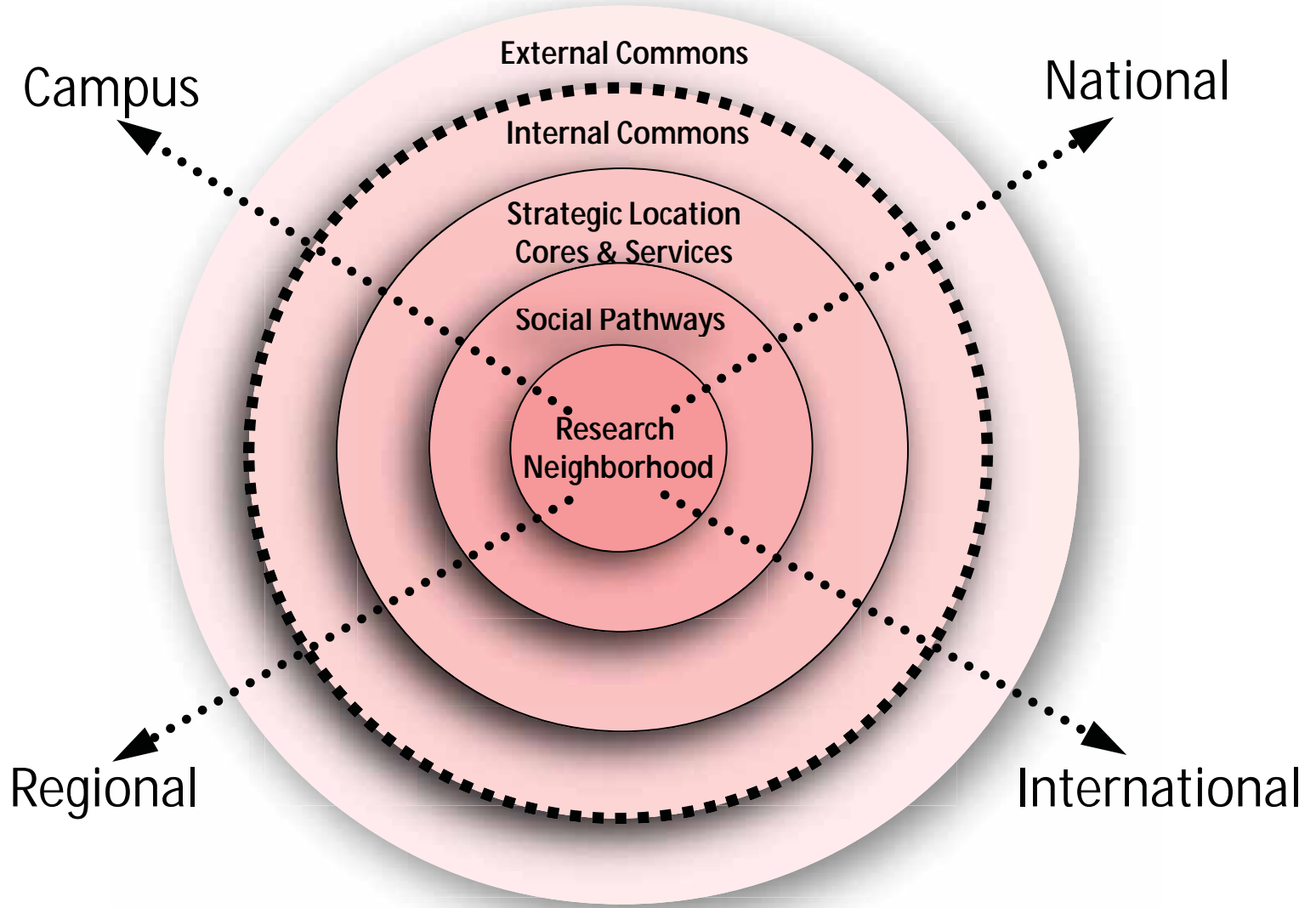
**Science**



**Computational**



# Social Interaction Continuum





# Connecting Communities





# Community / Town Center





# Innovation in Learning Environments / Utilization





# Open Space Architecture / Flexibility





# Paralleling Industry: Real World Connection



# Paralleling Industry: Entrepreneurship Clinic







- Integrating Science & Engineering in *Graduate / Post-Graduate* Setting:
  - Re-thinking Research and Teaching Relationship
  - Flexibility for an Even Broader Array of Disciplines (Wet, Dry)
  - Utilization Focus / Multi-Purposing
  - Neighborhoods and Communities – Beyond Walls and Campus
  - Architecture which Prioritizes Interaction-Based Collaboration



# The Science & Engineering Synergies & Concepts



Interchangeable Research/Teaching



Space Utilization



Visibility of Learning



Shared Cores



Research Performance



Team Based Research



Collaboration



Building Performance



Connecting Communities: Outreach

# The Tradeline Four

1. The Research / Teaching Neighborhood



2. Creating Potential for Collaboration



3. Higher Utilization & Multi-Purposing of Space



4. Open Architecture: Transparency & Systems







# Co-located Science & Engineering Programs – Models for Shared Success: Collaboration / Shared Resources / Higher Productivity

Presented by:

**Bill Gustafson, FAIA**  
**Craig S. Spangler, AIA**  
**Jeff French, FAIA**

**Tradeline**  
**Scottsdale, AZ**  
**October 13-14, 2011**

**BALLINGER**