THE NEW RESEARCH FACILITY VALUE METRICS:

INTERACTION | SUSTAINABILITY++ | PROJECT QUALITY

STEPHEN
BARTLETT, AIA, LEED AP

JONATHAN
FRIEDAN, PE, LEED AP

WILLIAM
GUSTAFSON, FAIA

THE NEW RESEARCH VALUE METRICS: INTERACTION | SUSTAINABILITY | PERFORMANCE

CONTINUUM OF RESEARCH + DEVELOPMENT

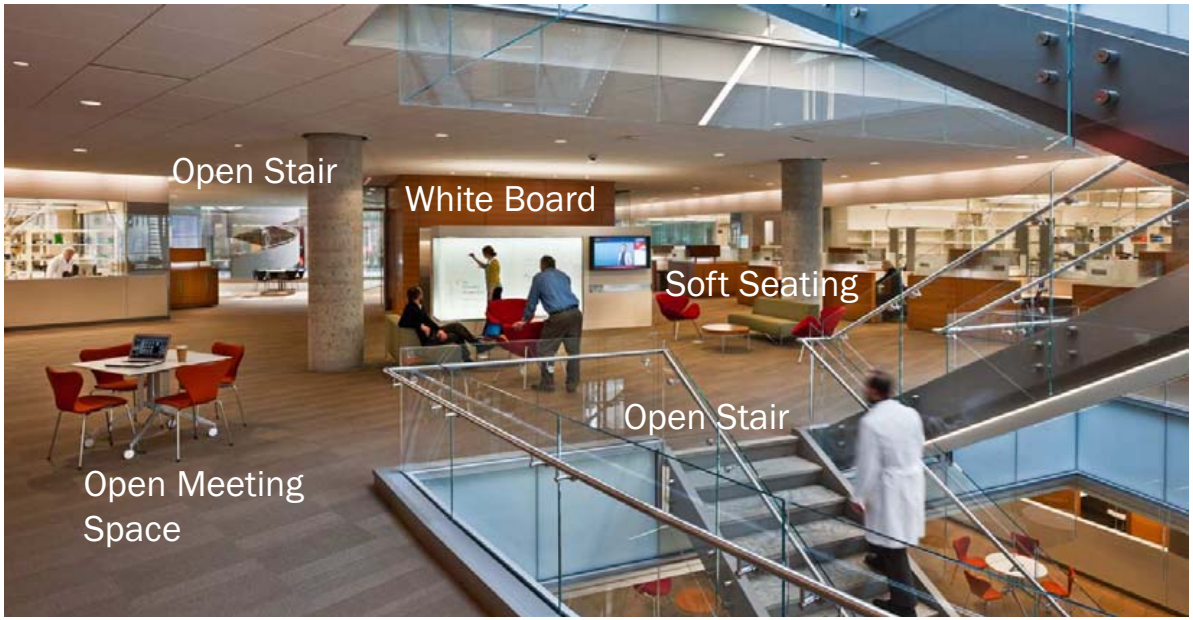
Thomas Edison Systemizes Research 1890-1930

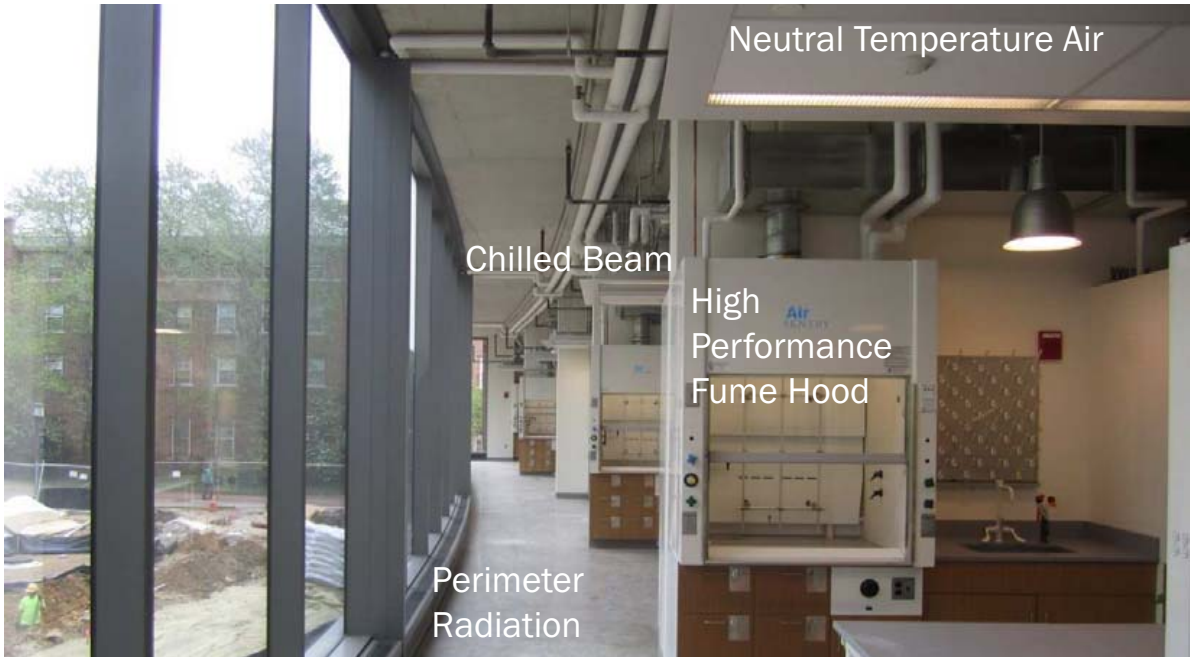
Francis Crick + James Watson Discover Double Helix 1953

Genome Mapped Francis Collins 1987 - 2003

Tom Allen Studies Research Organizations 1970 - 2010

A BRIEF HISTORY OF INNOVATION





TRADITIONAL METRICS

- Efficiency Net/Gross
- Lab / Lab Support Ratio
- Linear Foot of Bench / Researcher
- $/SF Productivity Measures

NEW METRICS

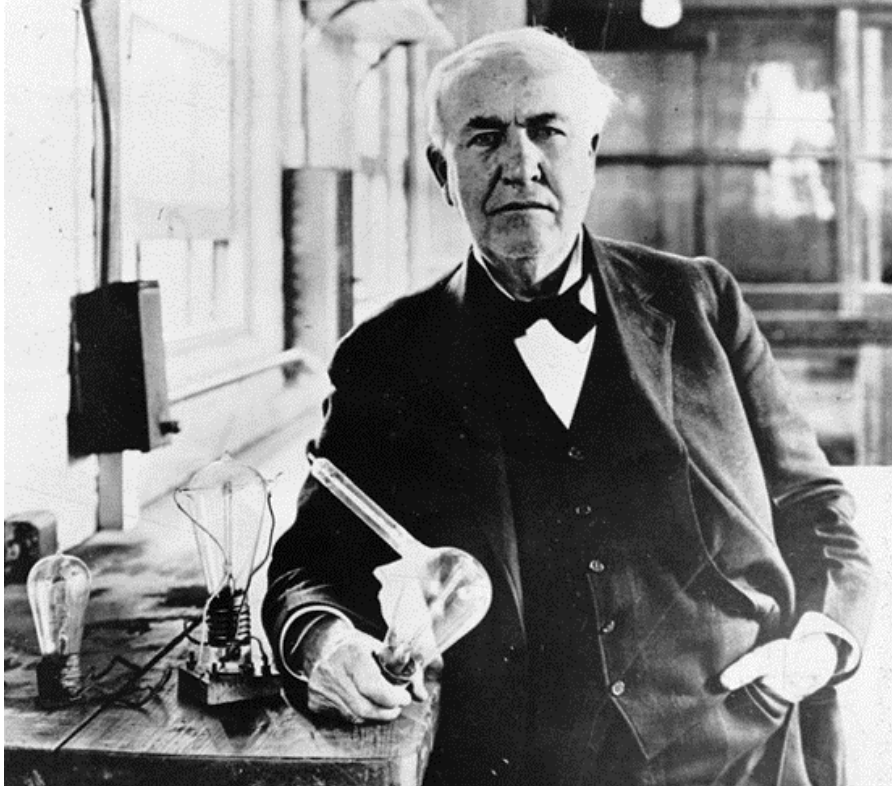
- Interaction Predictors
- Space & Systems Convertibility / Flexibility
- Low Energy Use / EUI

POST OCCUPANCY RESEARCH

THOMAS ALVA EDISON

Great American Inventor

- Most Prolific Innovator: 1000 + Patents
- Wide Ranging Interests:
  - Light Bulb
  - Phonograph
  - Mining Technology
  - Motion Picture
  - Telegraph
- “The Wizard of Menlo Park”
- Systemized Research + Development Process
- 60 Year Career



FRANCIS CRICK + JAMES WATSON

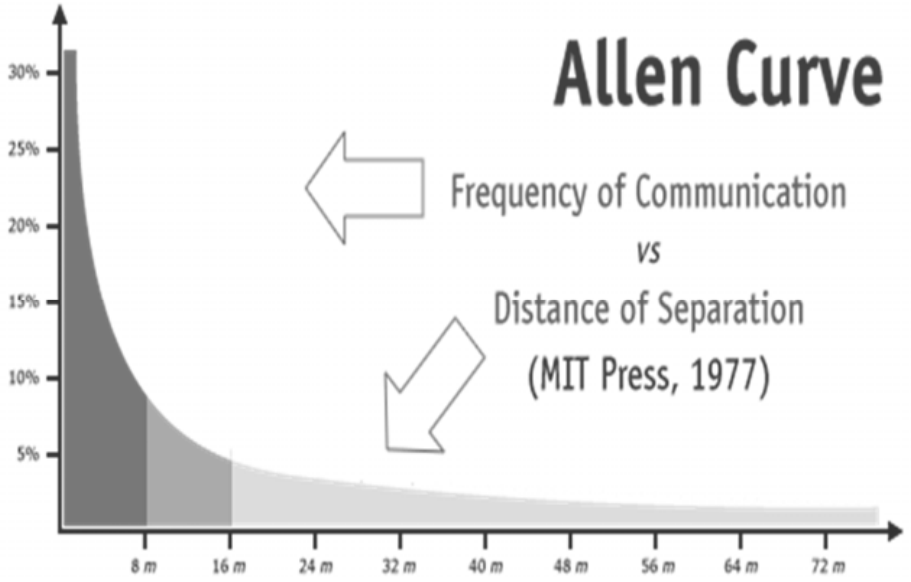
Discover Structure of DNA

- Circuitous Path of Watson to Reach England
- Interacted with Scientists around the World. e.g. Linus Pauling
- Cross Disciplinary Focus:
  - Biology
  - Chemistry
  - X-Ray Crystallography
  - Physics
- Created Model of the Double Helix
- Nobel Prize in 1962 with Wilkins
- Watson involved with mapping genome:
  1986 – 1998 with Francis Collins

THOMAS ALLEN

Sloan School | MIT 1986 - Present

- Hypothesized the Role of Distance Influencing Research Collaboration (The Allen Curve)
- Studied Research + Development Organizational Models: Developed Theories about Variables in Research Effectiveness
  - Cross Disciplinary Work Discipline
  - Project Based vs. Focus
  - Fast Paced Knowledge Accumulation
  - High Interdependence
- Created Language to Describe Physical Parameters of Collaboration
  - Caves + Commons
  - Interaction Space
  - Research Neighborhood



THE CHALLENGE OF RESEARCH BUILDING EFFICIENCY

So, if we do a better job of designing the can, will we be able to pack more fish inside while using the same amount of tin?

WHAT FACTORS DETERMINE RESEARCH BUILDING PERFORMANCE?

OR RATHER....

WHAT DO WE MEASURE TO COMPARE CREATIVE ENVIRONMENTS THAT WILL FOSTER RESEARCH BREAKTHROUGHS?

SEED CHECKLIST: A Comprehensive Approach

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

Core Values + Drivers

- Amenity
- Visibility
- Community
- Density

NEW METRICS BUILT AROUND INTERACTION ENCOURAGING FACTORS

Interaction Seats

What is the ratio of assigned (FTE) seats to open seats available for interactions?

What is the ratio of these to those?

NEW METRICS BUILT AROUND INTERACTION ENCOURAGING FACTORS

How many people
share food or coffee stations
on a research floor plate?

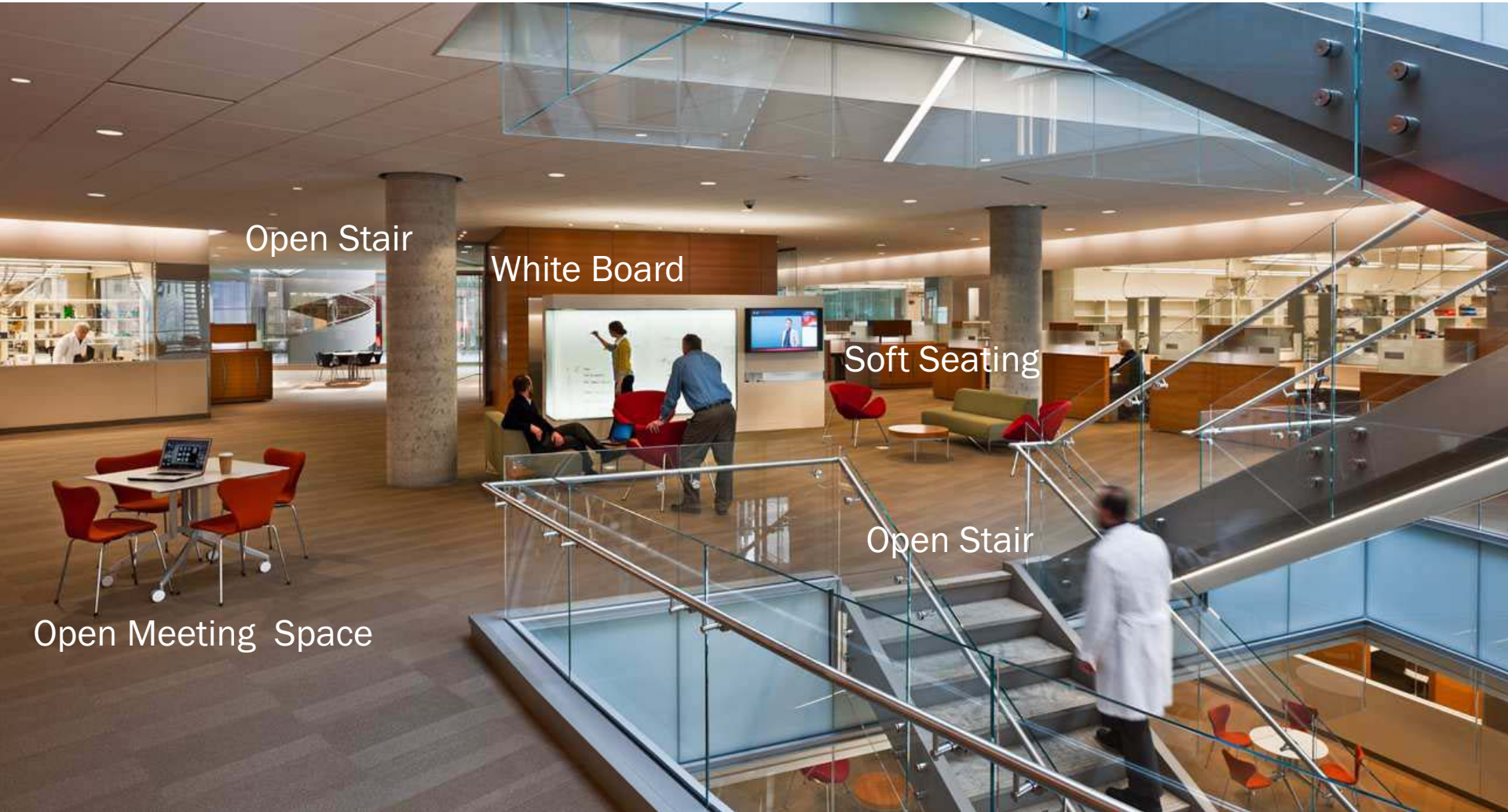
NEW METRICS BUILT AROUND INTERACTION ENCOURAGING FACTORS

FTE/Spatial Neighborhood

How many people share a perceptible spatial neighborhood?

NEW METRICS BUILT AROUND INTERACTION ENCOURAGING FACTORS

What is the ratio of draws (amenities) to personnel (FTE) on a research floor plate?



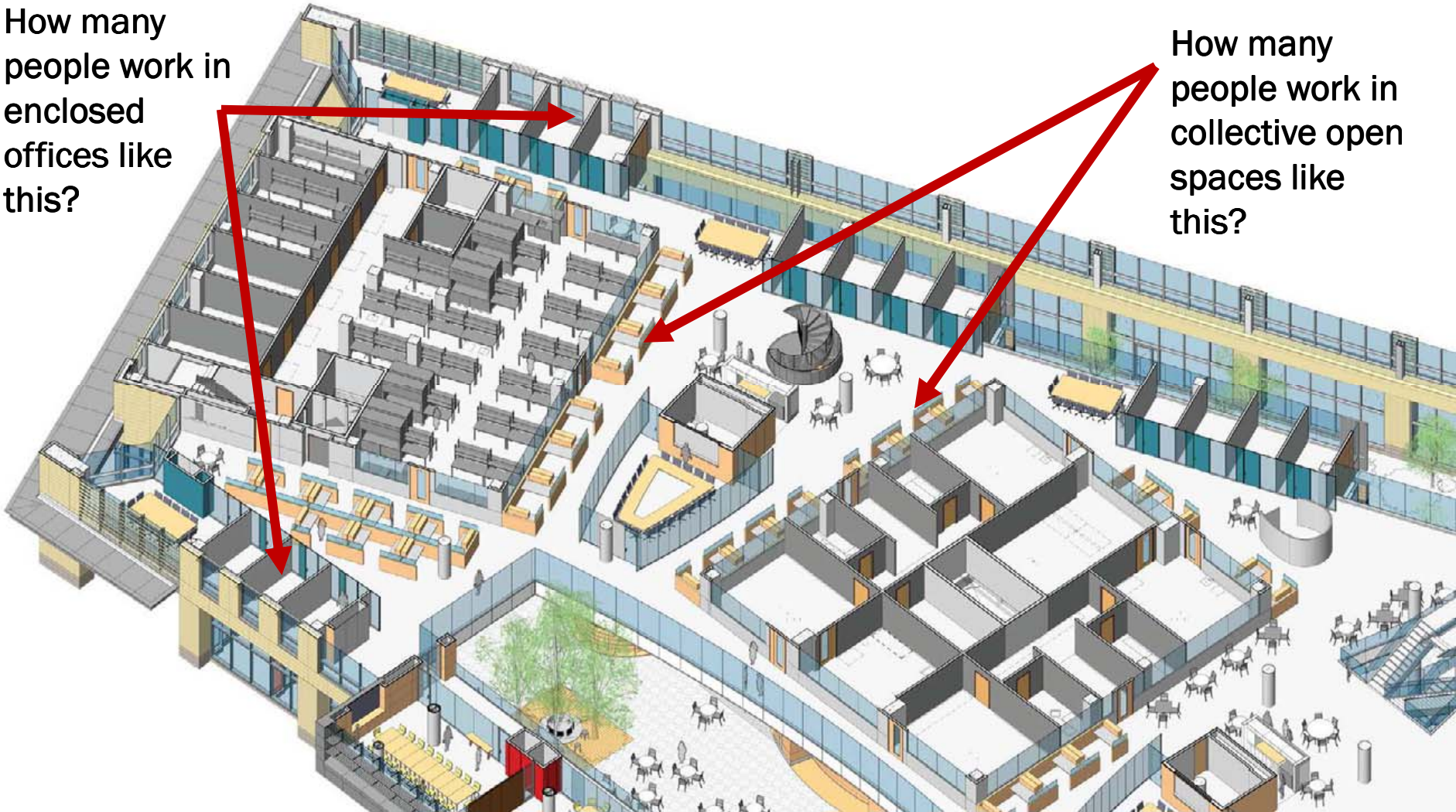
NEW METRICS BUILT AROUND INTERACTION ENCOURAGING FACTORS

What is the numerical average
of people per room
on a research floor plate?

Average FTE/Room

How many people work in enclosed offices like this?

How many people work in collective open spaces like this?

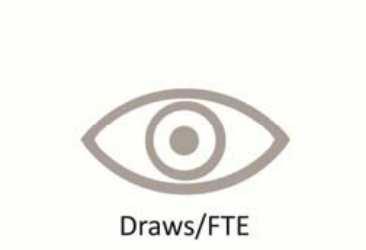


NEW METRICS BUILT AROUND INTERACTION ENCOURAGING FACTORS

What percentage of the total seats on a research floor plate are open for interactions?

How many people share a food or coffee station on a research floor plate?

How many people share a perceptible spatial neighborhood on a research floor plate?



What is the ratio of draws (amenities) to personnel (FTE) on a research floor plate?

What is the numerical average of people per room on a research floor plate?

BROWN UNIVERSITY

Sydney Frank Life Sciences Building

BALLINGER

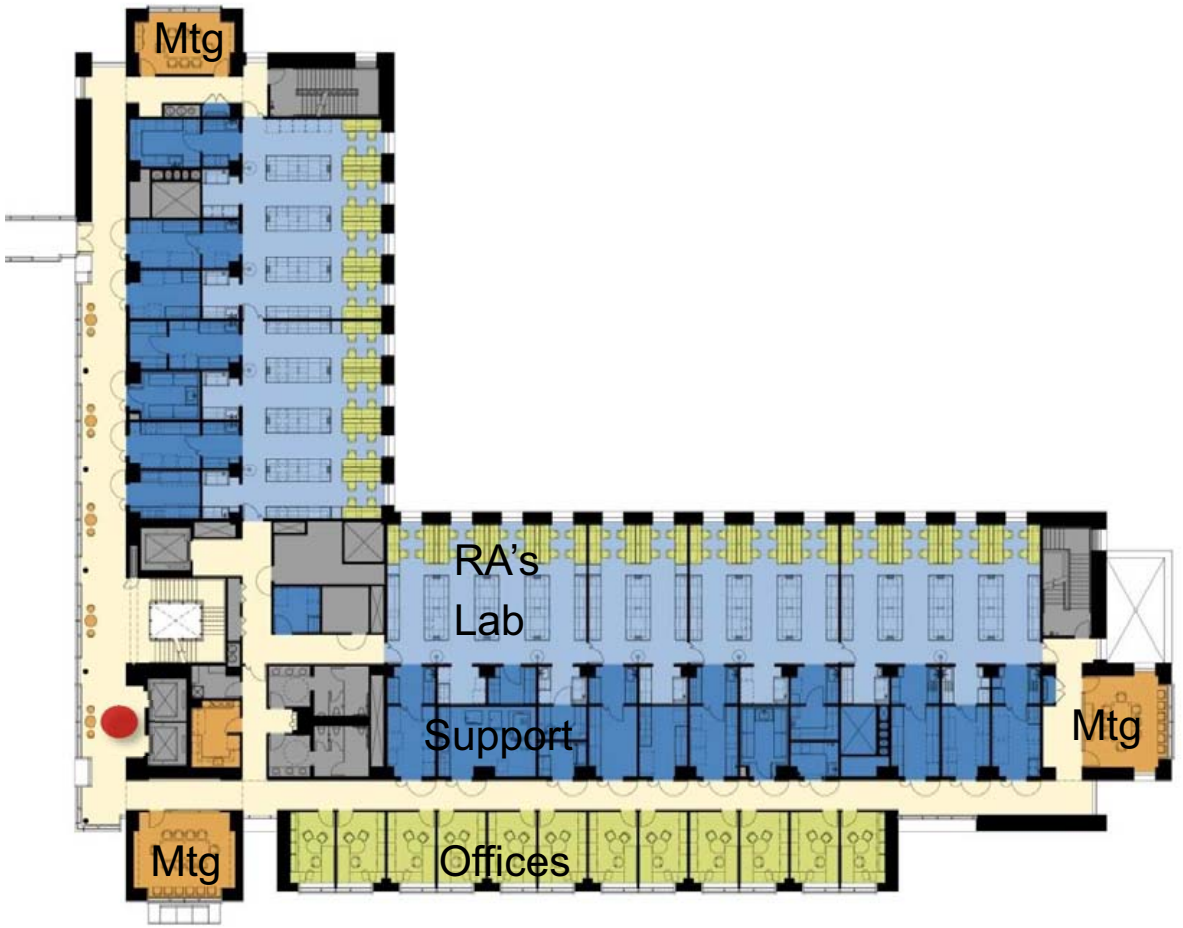
175,000 GSF | 2006

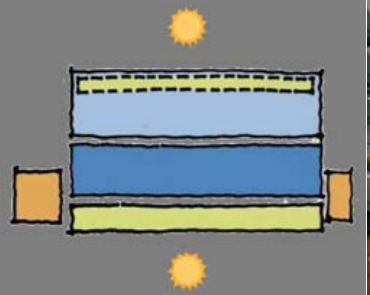
BROWN UNIVERSITY Sydney Frank Life Sciences Building

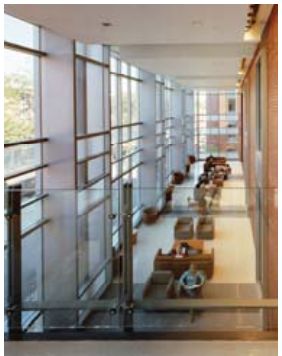
Traditional Metrics & Factors

Area:
GSF: 22,300 sf
NSF: 14,700 sf
Efficiency: 66%
1,225 NSF/PI

Density:
96 FTE/floor
232 GSF/FTE
150 NSF/FTE
79% Wet
15 LF eq. / FTE







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232 GSF/FTE
150 NSF/FTE
79% Wet
15 LF eq. / FTE

New Metrics

Draws: 6 Total
Conf. Room: 3
Kitchenette: 1
Open Stair: 1
Open Seating: 1

Spatial Neighborhoods:
2 Total –
Control Area Driven

27%	1/96	42	1/16	5
Interaction Seats	Food & Coffee/FTE	FTE/Spatial Neighborhood	Draws/FTE	Average FTE/Room

APPLICATION OF NEW METRICS TO BALLINGER WORK OF PAST 12 YEARS

VISTAKON

CHOP

WISTAR

JHU UTL

WEST

2002 2014

BROWN

PITT

WID-MIR

JHU BE2

GWU

VISTAKON

Research + Development Building

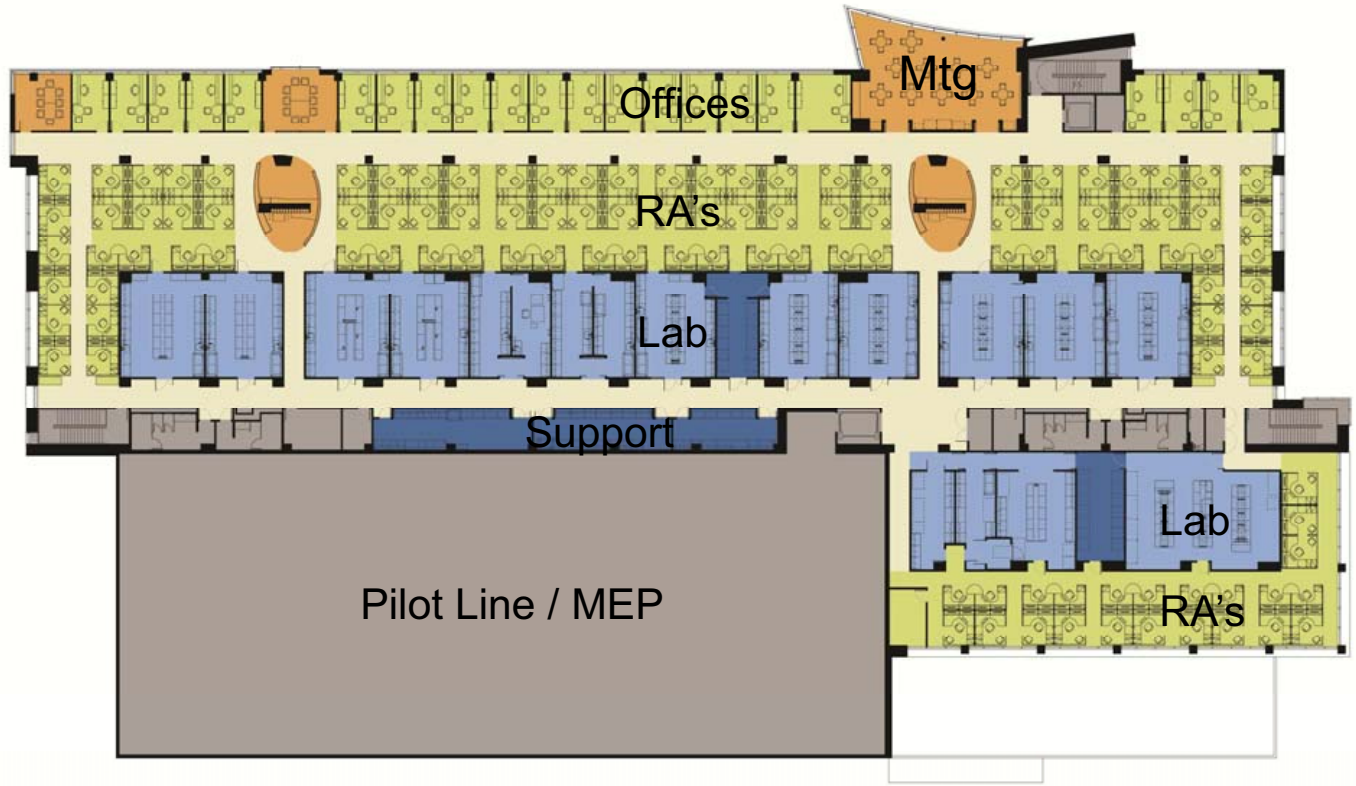
BALLINGER

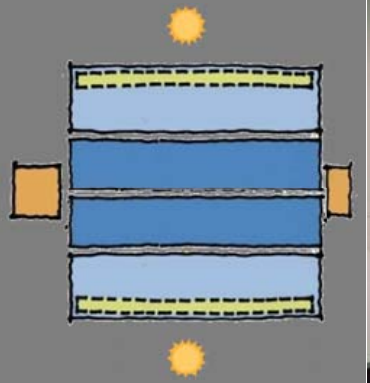
150,000 GSF | 2002

Traditional Metrics and Factors

Area:
GSF: 40,670 sf
NSF: 26,500 sf
Efficiency: 68%

Density:
137 FTE/floor
310 GSF/FTE
200 NSF/FTE
45% Wet
15 LF eq. / FTE





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Efficiency: 68%

Density:
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310 GSF/FTE
200 NSF/FTE
45% Wet
15 LF eq. / FTE

New Metrics

Draws: 7 Total
Conf. Room: 3
Kitchenette: 2
Copy Area: 2

Spatial Neighborhoods:
4 Total

23%	1/68	39	1/20	5
Interaction Seats	Food & Coffee/FTE	FTE/Spatial Neighborhood	Draws/FTE	Average FTE/Room

THE CHILDREN'S HOSPITAL OF PHILADELPHIA

Colket Translational Research Center

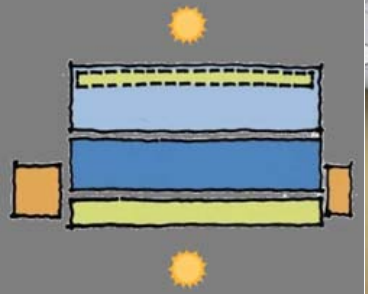
BALLINGER

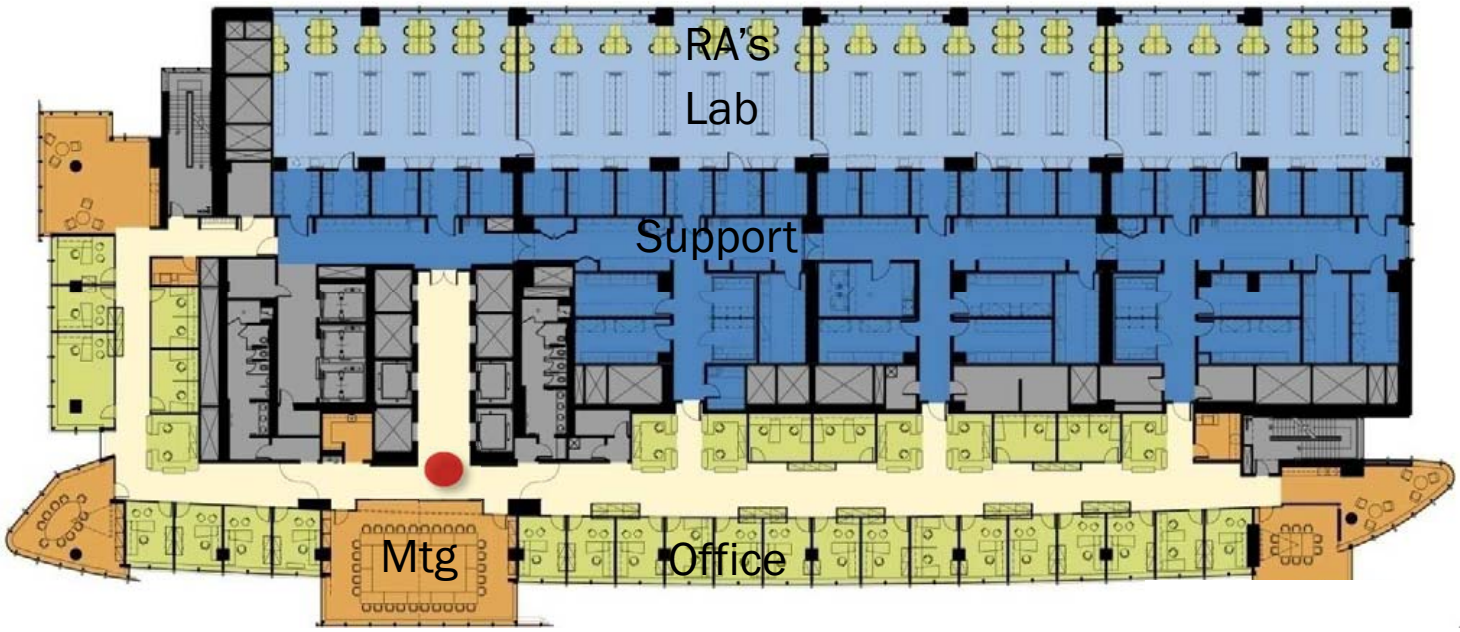
1,275,000 GSF | 2009

Traditional Metrics & Factors

Area:
GSF: 38,550 sf
NSF: 27,500 sf
Efficiency: 71%
1,250 NSF/PI

Density:
130 FTE/floor
320 GSF/FTE
230 NSF/FTE
69% Wet
14 LF eq. / FTE





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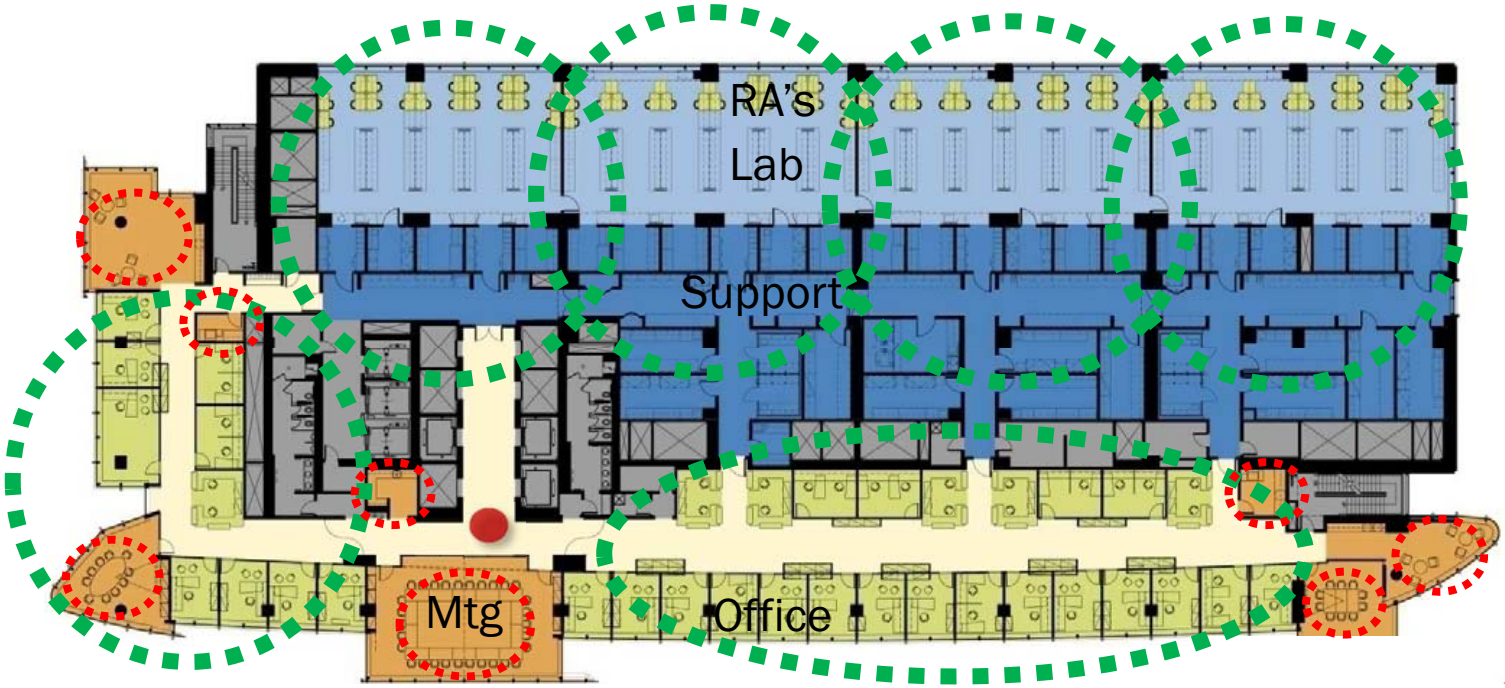
Efficiency: 71%
1,250 NSF/PI

Density:
130 FTE/floor
320 GSF/FTE
230 NSF/FTE
69% Wet
14 LF eq. / FTE

New Metrics

Draws: 6 Total
Conf. Room: 3
Kitchenette: 2
Copy Area: 1

Spatial Neighborhoods:
6 Total



32%	1/65	22	1/17	4
Interaction Seats	Food & Coffee/FTE	FTE/Spatial Neighborhood	Draws/FTE	Average FTE/Room

THE WISTAR INSTITUTE

Vivarium Relocation + New Research Tower

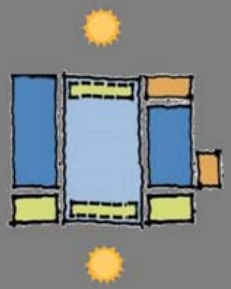
BALLINGER

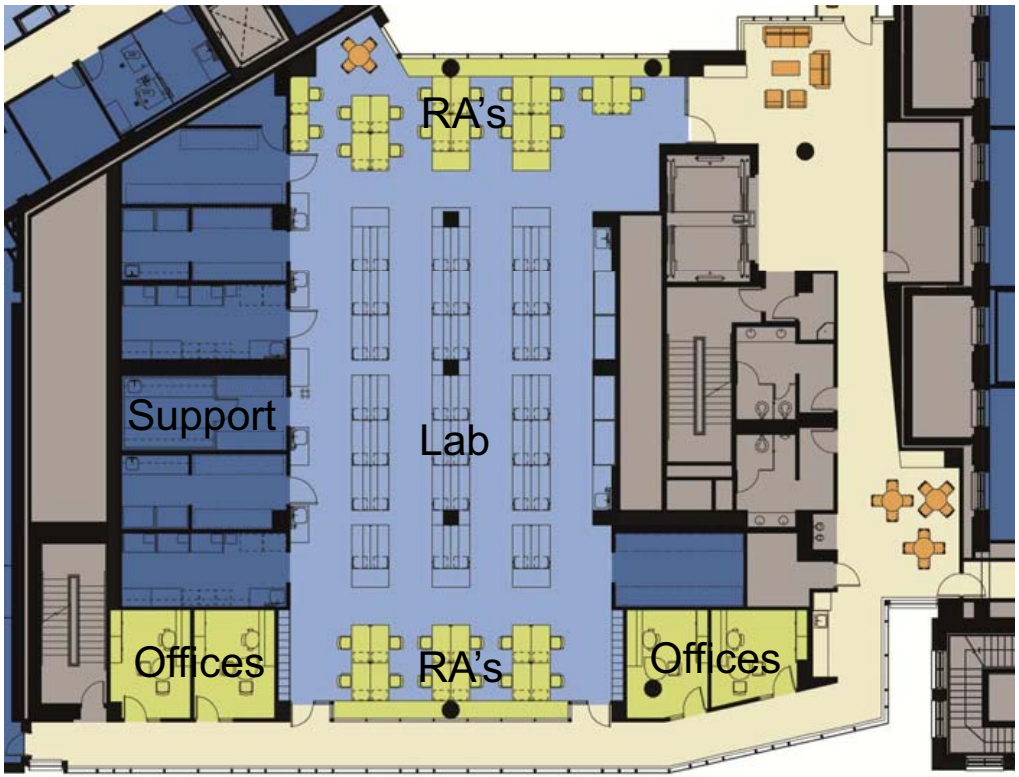
95,000 GSF | 2014

Traditional Metrics and Factors

Area:
GSF: 10,783 sf
NSF: 6,790 sf
Efficiency: 63%
1,670 NSF/PI

Density:
36 FTE/floor
299 GSF/FTE
188 NSF/FTE
69% Wet
18 LF eq. / FTE





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NSF: 6,790 sf
Efficiency: 63%
1,670 NSF/PI

Density:
36 FTE/floor
299 GSF/FTE
188 NSF/FTE
69% Wet
18 LF eq. / FTE

New Metrics

Draws: 3 Total
Meeting: 1
Kitchenette: 1
Open Seating: 1

Spatial Neighborhoods:
1 Total

25%	1/36	32	1/12	8
Interaction Seats	Food & Coffee/FTE	FTE/Spatial Neighborhood	Draws/FTE	Average FTE/Room

THE WISCONSIN INSTITUTES FOR DISCOVERY

University of Wisconsin Madison

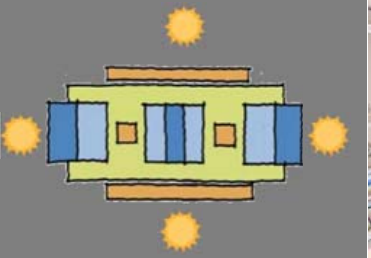
BALLINGER

330,000 GSF | 2010

Traditional Metrics and Factors

Area:
GSF: 54,350 sf
NSF: 36,950 sf
Efficiency: 66%
1,850 NSF/PI

Density:
156 FTE/floor
348 GSF/FTE
236 NSF/FTE
30 - 45 % Wet
17 LF eq. / FTE



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Density:
156 FTE/floor
348 GSF/FTE
236 NSF/FTE
30 - 45 % Wet
17 LF eq. / FTE

New Metrics

Draws: 20 Total
Meeting: 8
Kitchenette: 3
Open Seating: 6
Open Stairs: 3

Spatial Neighborhoods:
2 Total

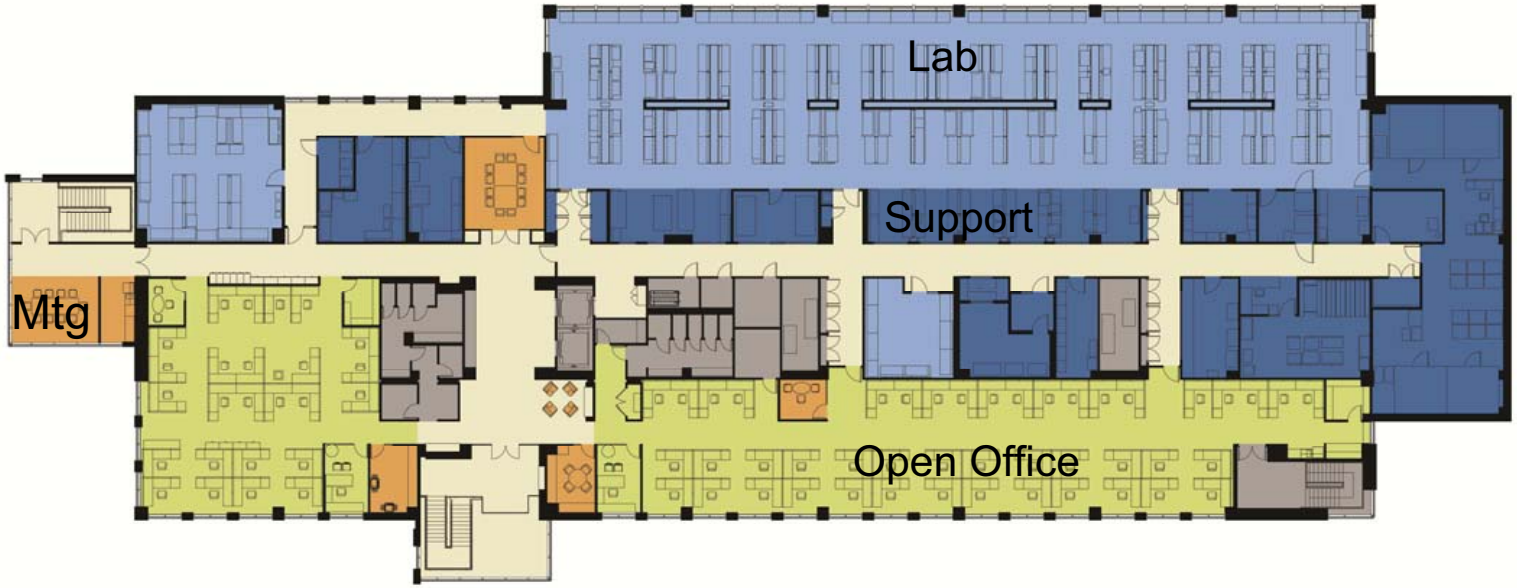
63%	1/52	78	1/8	7
Interaction Seats	Food & Coffee/FTE	FTE/Spatial Neighborhood	Draws/FTE	Average FTE/Room

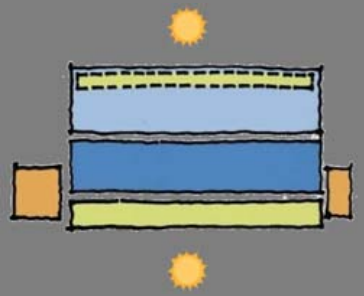

WEST PHARMACEUTICAL
Headquarters
BALLINGER
170,000 GSF | 2013

Traditional Metrics and Factors

Area:
GSF: 32,797 sf
NSF: 21,859 sf
Efficiency: 67%

Density:
88 FTE/floor
372 GSF/FTE
248 NSF/FTE
66% Wet
20 LF eq. / FTE





WEST PHARMACEUTICAL

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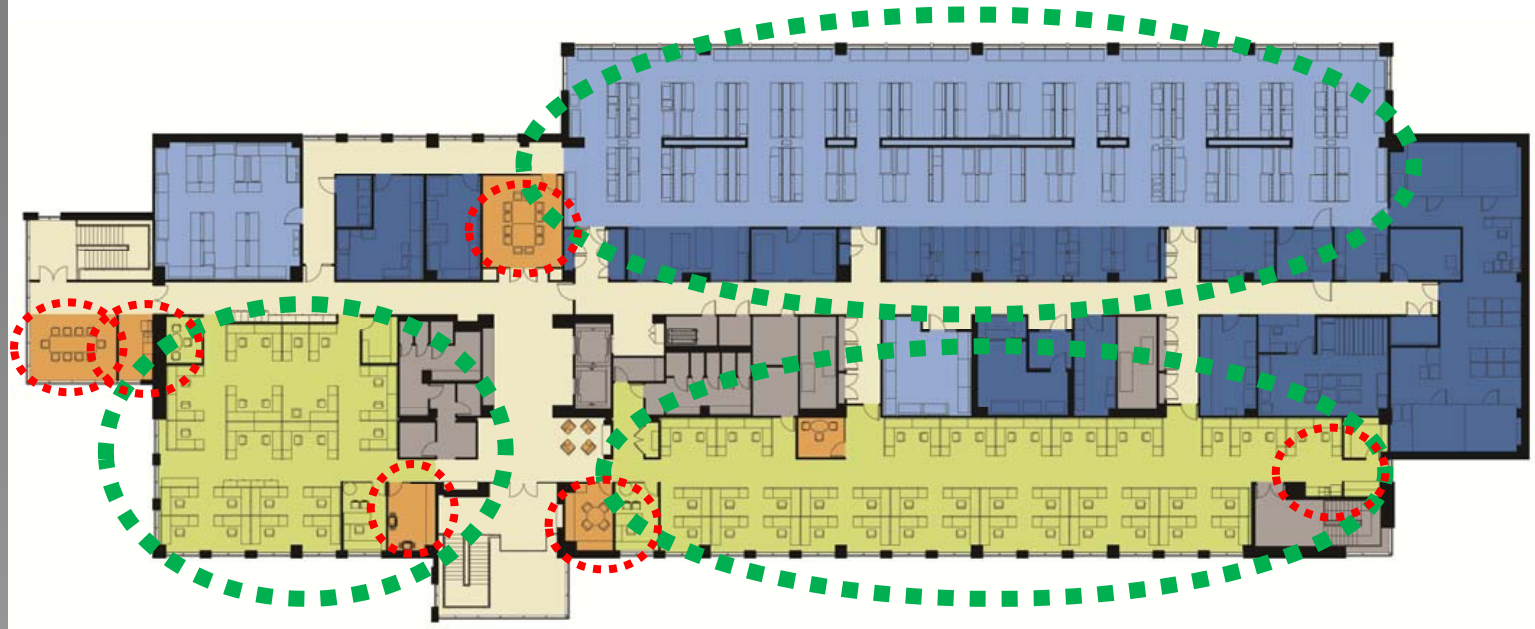
Efficiency: 67%

Density:
88 FTE/floor
372 GSF/FTE
248 NSF/FTE
66% Wet
20 LF eq. / FTE

New Metrics

Draws: 6 Total
Conf. Room: 3
Kitchenette: 2
Copy Area: 1

Spatial Neighborhoods:
3 Total



29%	1/44	29	1/15	15
Interaction Seats	Food & Coffee/FTE	FTE/Spatial Neighborhood	Draws/FTE	Average FTE/Room

GEORGE WASHINGTON UNIVERSITY

Science + Engineering Hall

BALLINGER

500,000 GSF | 2012

GEORGE WASHINGTON UNIVERSITY Science + Engineering Hall

Traditional Metrics and Factors

Area:
GSF: 51,159 sf
NSF: 33,814 sf
Efficiency: 66%
1,525 NSF/PI

Density:
178 FTE/floor
287 GSF/FTE
189 NSF/FTE
56% Wet
11 LF eq. / FTE

GEORGE WASHINGTON UNIVERSITY Science + Engineering Hall

Traditional Metrics and Factors

Area:
GSF: 51,159 sf
NSF: 33,814 sf
Efficiency: 66%
1,525 NSF/PI

Density:
178 FTE/floor
287 GSF/FTE
189 NSF/FTE
56% Wet
11 LF eq. / FTE

New Metrics

Draws: 14 Total
Meeting: 3
Kitchenette: 3
Open Seating: 5
Open Stairs: 3

Spatial Neighborhoods:
3 Total

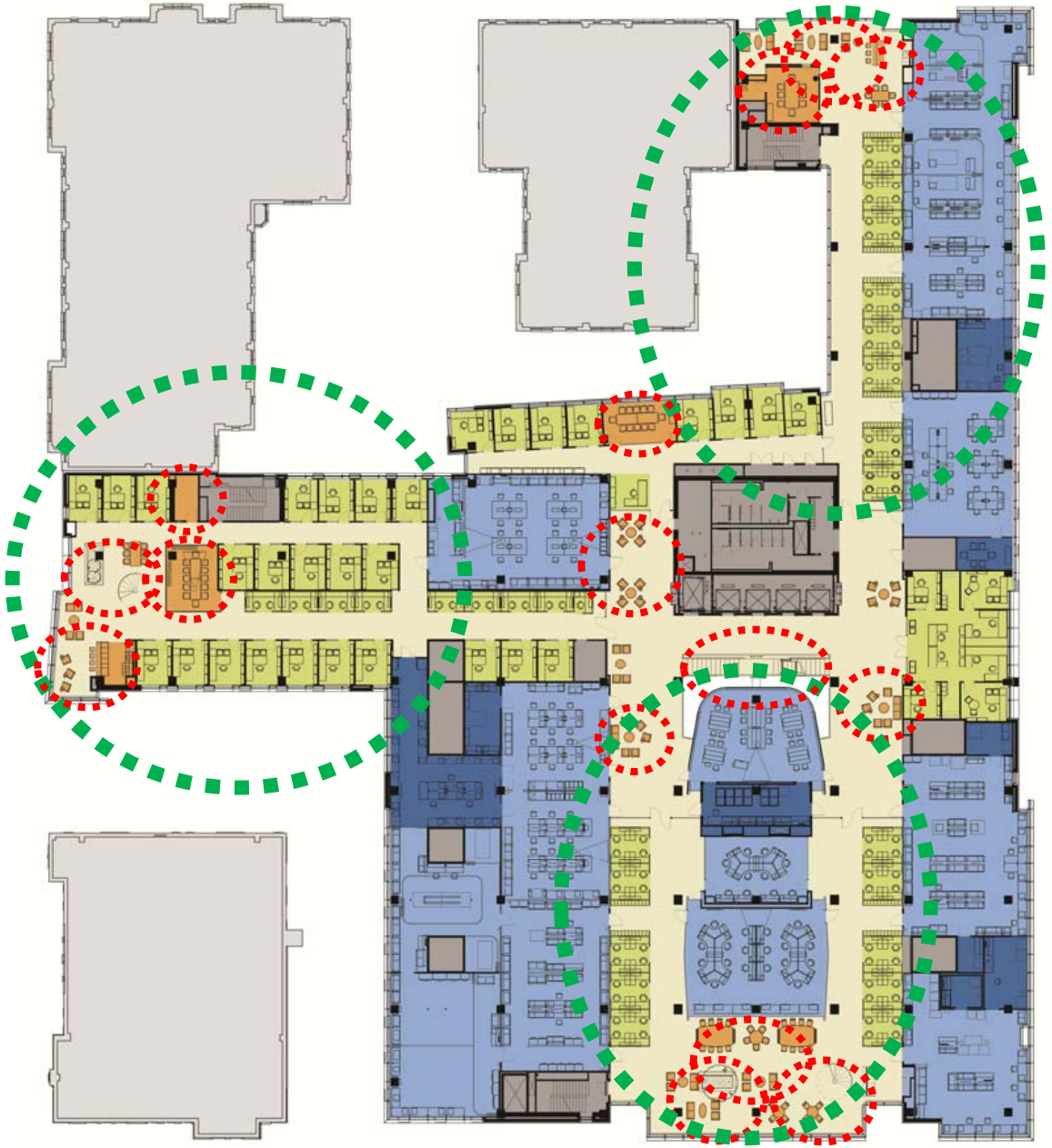
43%
Interaction Seats

1/60
Food & Coffee/FTE

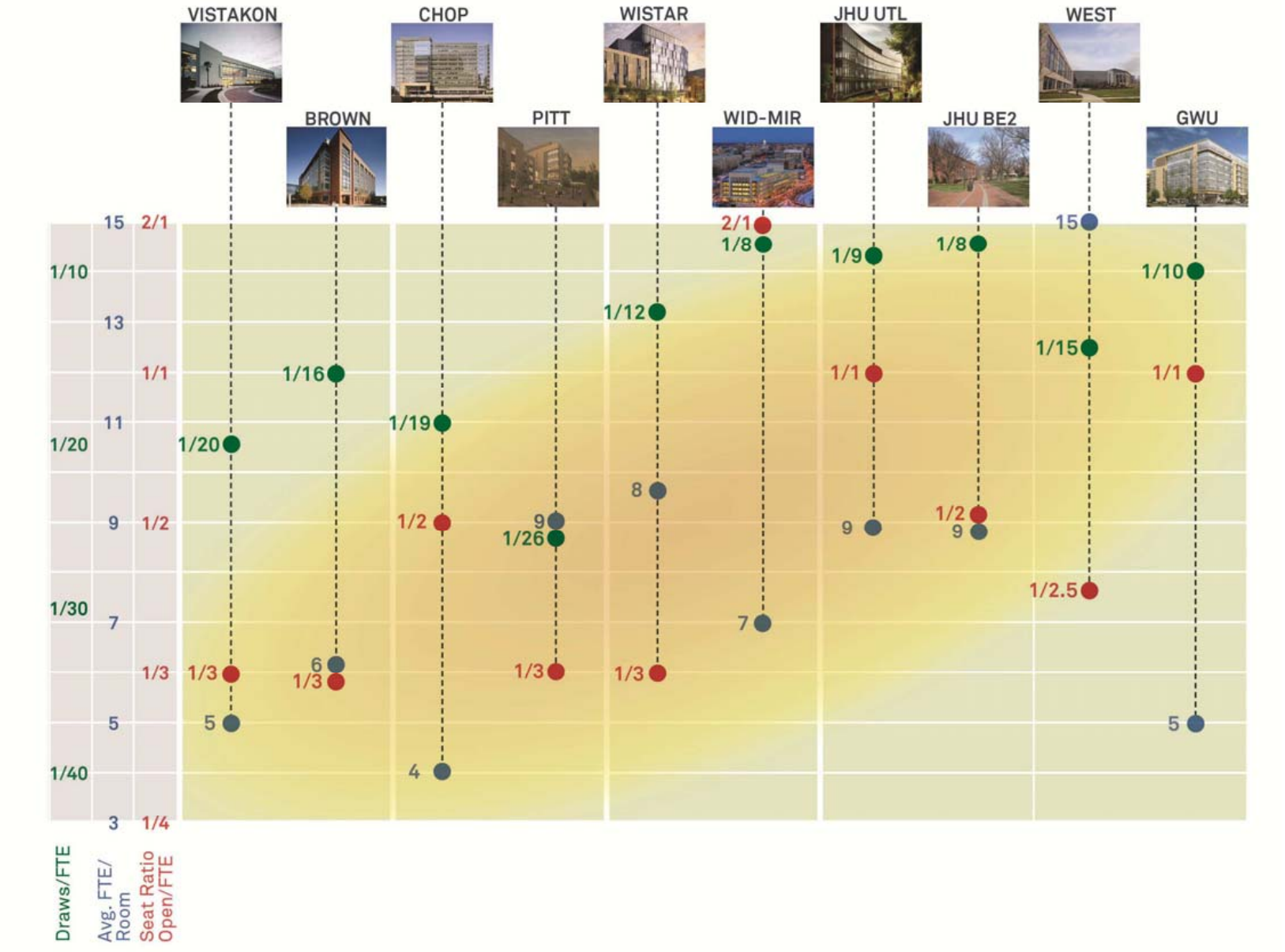
60
FTE/Spatial Neighborhood

1/11
Draws/FTE

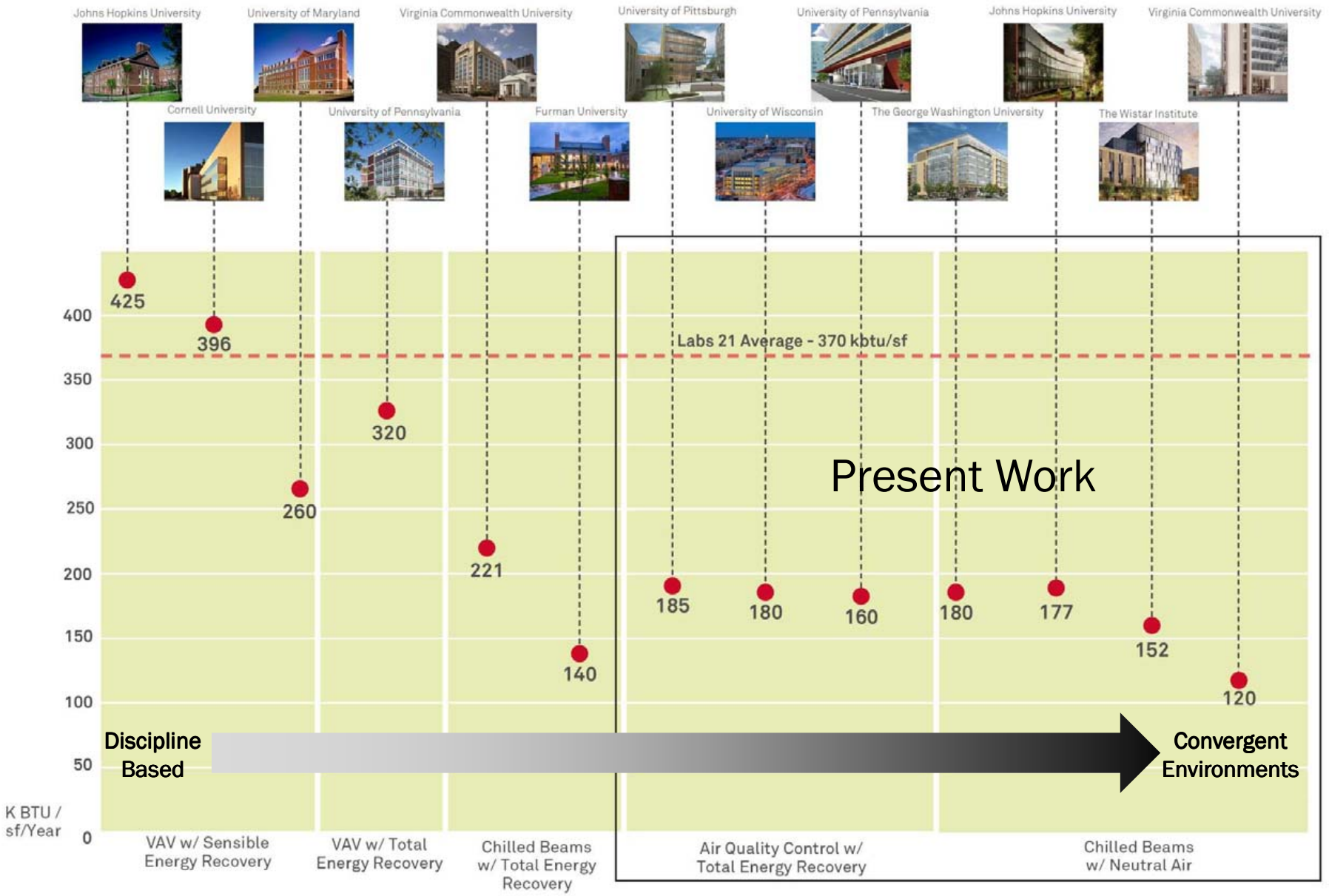
5
Average FTE/Room



Interaction Metrics: 10 Year Trend



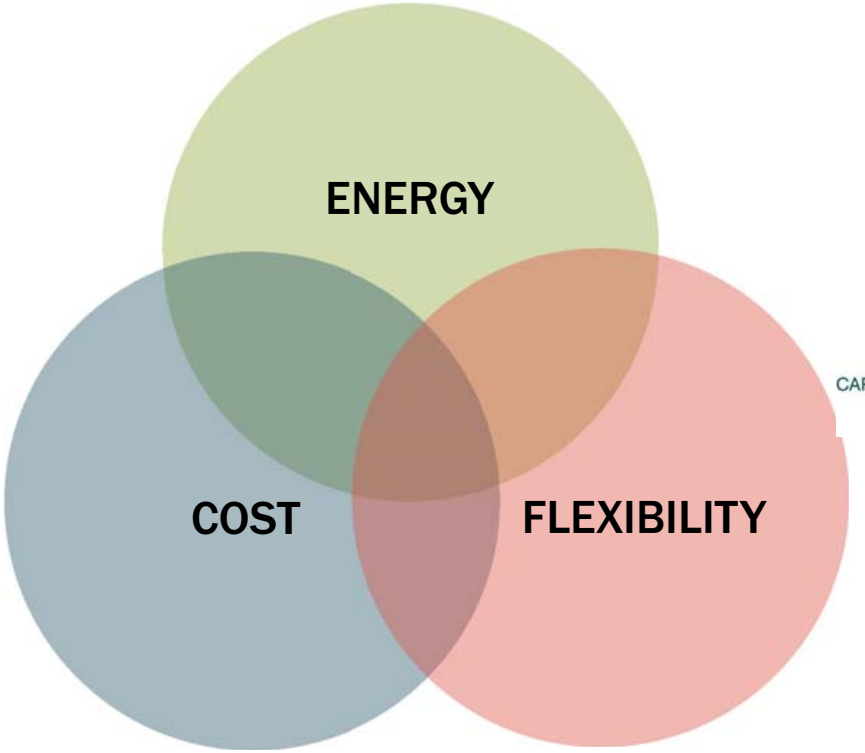
Energy Efficiency Metrics: 10 Year Trend

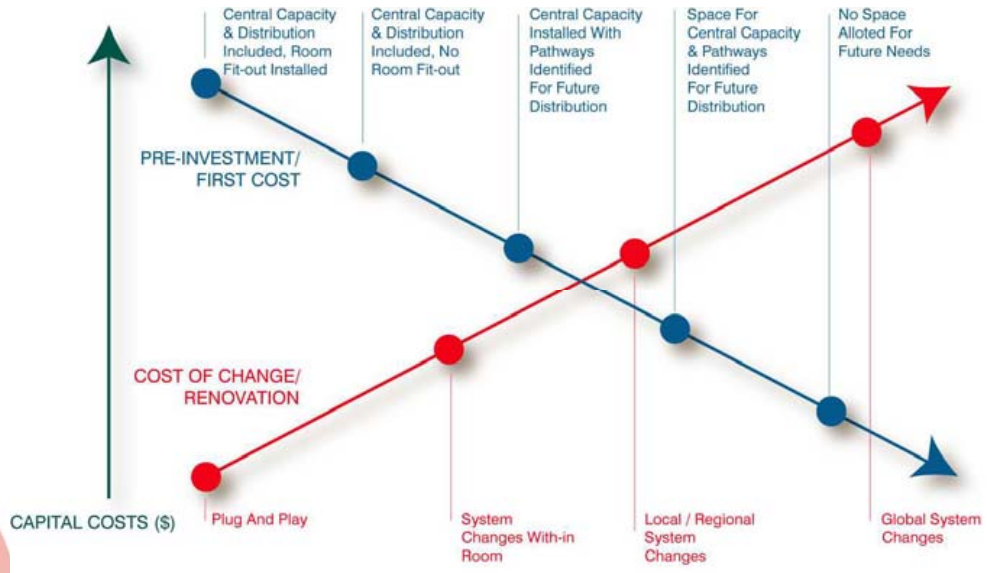


THE CHALLENGE OF INFRASTRUCTURE FOR RESEARCH BUILDINGS:

So, if research happens in every space type and evolves over time; what infrastructure will be ***flexible / convertible*** *enough?*

INFRASTRUCTURE FLEXIBILITY

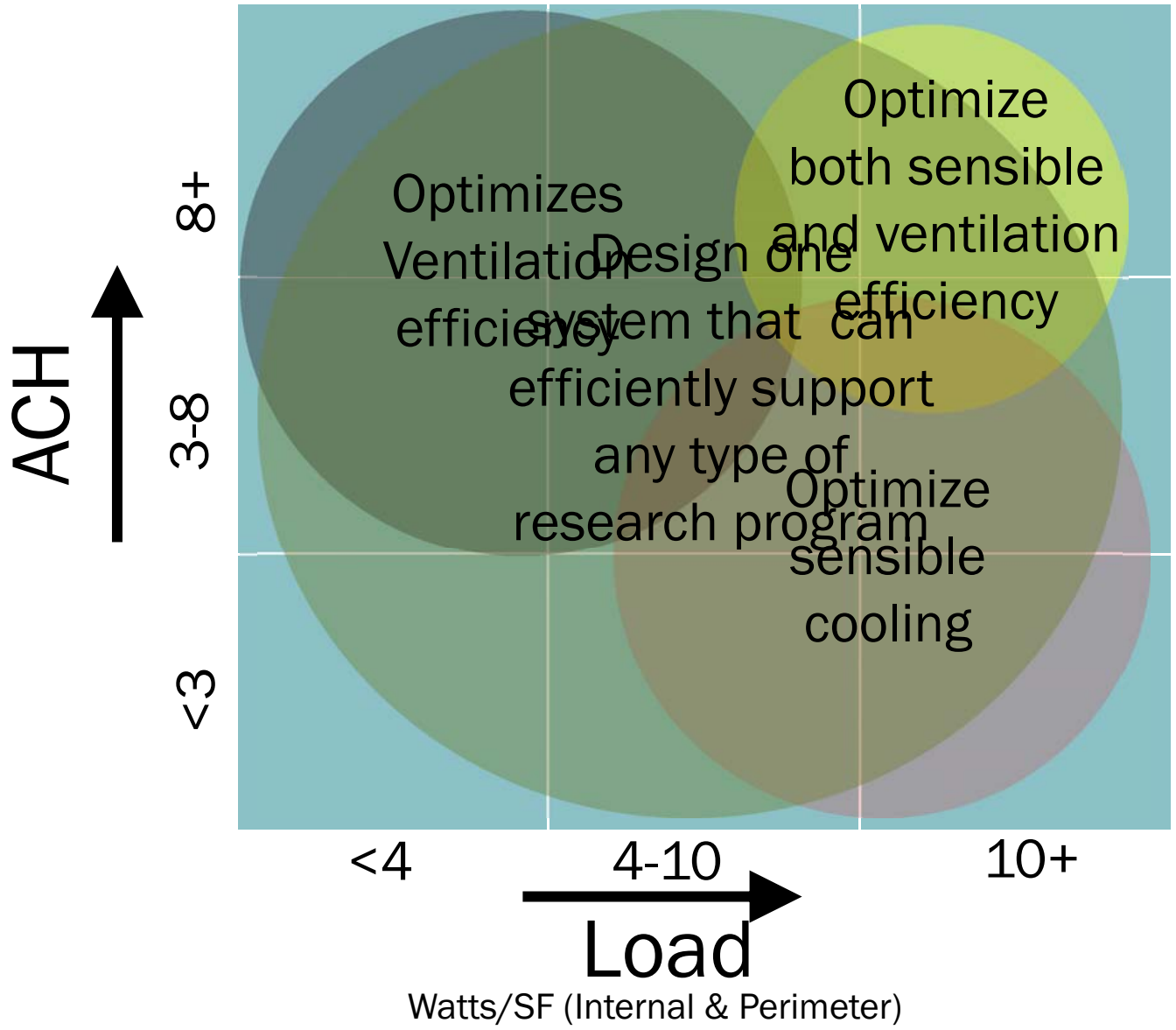




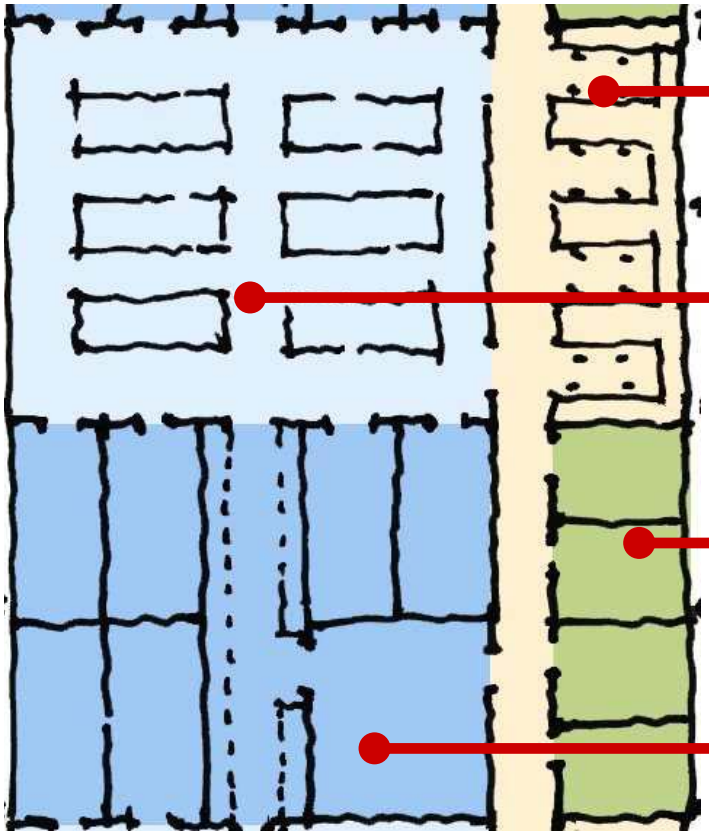
RANGE OF FLEXIBILITY

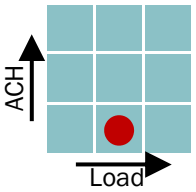
LOW | MODERATE | HIGH

Optimizing Infrastructure for Research Spectrum



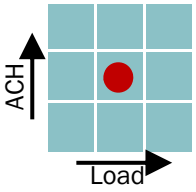
RESEARCH MODULE: 70% WET LABORATORY





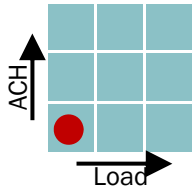
DRY RESEARCH: 20%

Minimum AC/Hr	2
Design Internal load	4w/sf
Ave. Internal Load	2.5w/sf



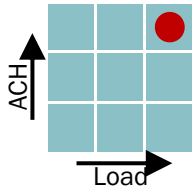
OPEN BENCH WET LAB: 35%

Minimum AC/Hr	6
Design Internal load	8w/sf
Ave. Internal Load	3w/sf



OFFICE: 10%

Minimum AC/Hr	<2
Design Internal load	3w/sf
Ave. Internal Load	2w/sf

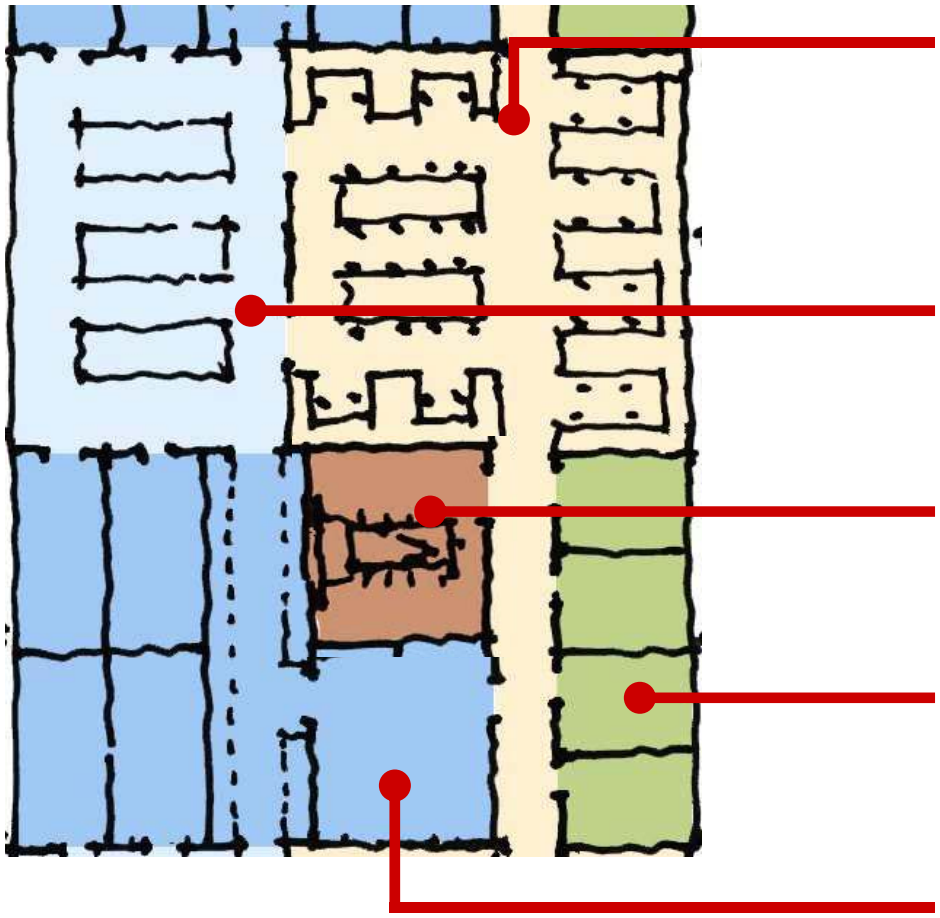


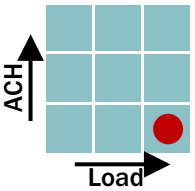
LAB SUPPORT: 35%

Minimum AC/Hr	6
Design Internal load	12w/sf
Ave. Internal Load	6w/sf

- **OPEN BENCH WET LAB : LAB SUPPORT = 1:1**
- **1 PI PER 1,400 SF**

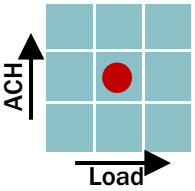
RESEARCH MODULE: 50% WET LABORATORY





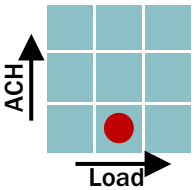
DRY RESEARCH: 30%

Minimum AC/Hr	2
Design Internal load	6w/sf
Ave. Internal Load	3w/sf



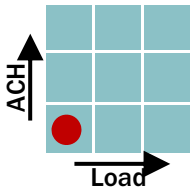
OPEN BENCH WET LAB: 20%

Minimum AC/Hr	6
Design Internal load	8w/sf
Ave. Internal Load	3w/sf



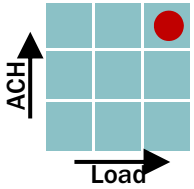
CONFERENCE: 10%

Minimum AC/Hr	3
Design Internal load	4w/sf
Ave. Internal Load	2w/sf



OFFICE: 10%

Minimum AC/Hr	<2
Design Internal load	3w/sf
Ave. Internal Load	2w/sf

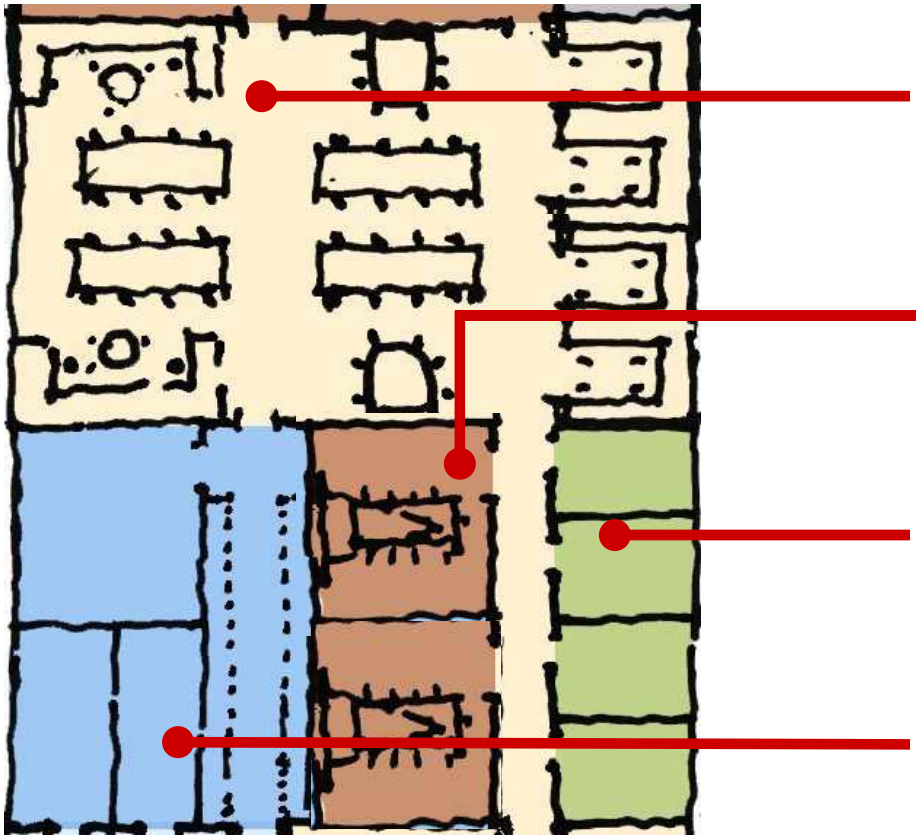


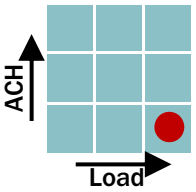
LAB SUPPORT: 30%

Minimum AC/Hr	6
Design Internal load	12w/sf
Ave. Internal Load	6w/sf

- **OPEN BENCH WET LAB : LAB SUPPORT = 1:1.5**
- **1 PI PER 1,400 SF**
- **DRY RESEARCH : WET RESEARCH = 1:1.5**

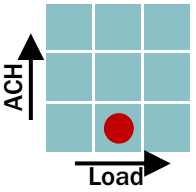
RESEARCH MODULE: 20% WET LABORATORY





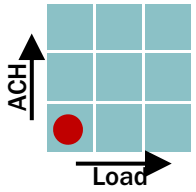
DRY RESEARCH: 50%

Minimum AC/Hr	2
Design Internal load	6w/sf
Ave. Internal Load	3w/sf



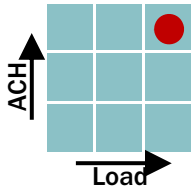
CONFERENCE: 20%

Minimum AC/Hr	3
Design Internal load	4w/sf
Ave. Internal Load	2w/sf



OFFICE: 10%

Minimum AC/Hr	<2
Design Internal load	3w/sf
Ave. Internal Load	2w/sf

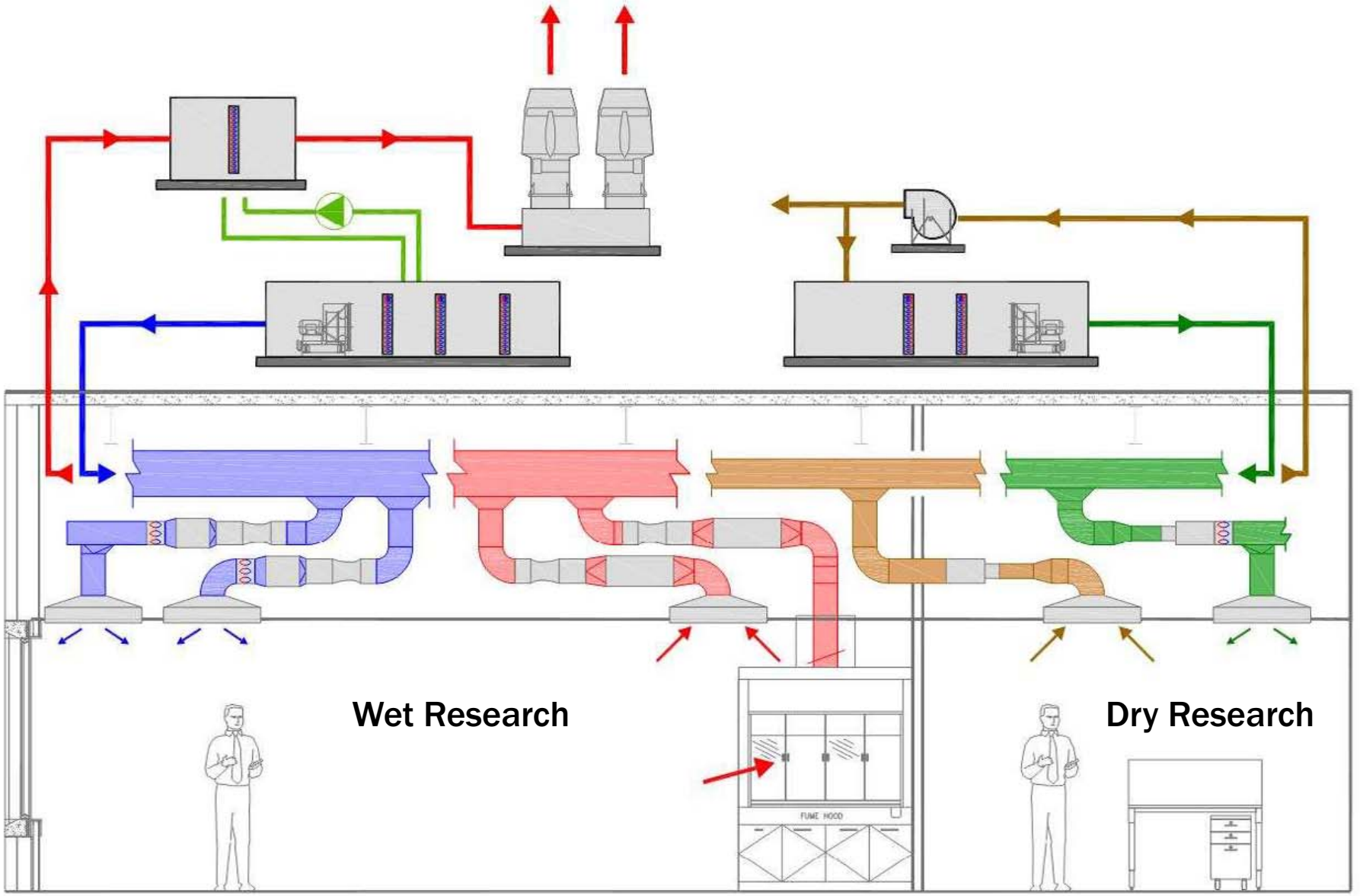


LAB SUPPORT: 20%

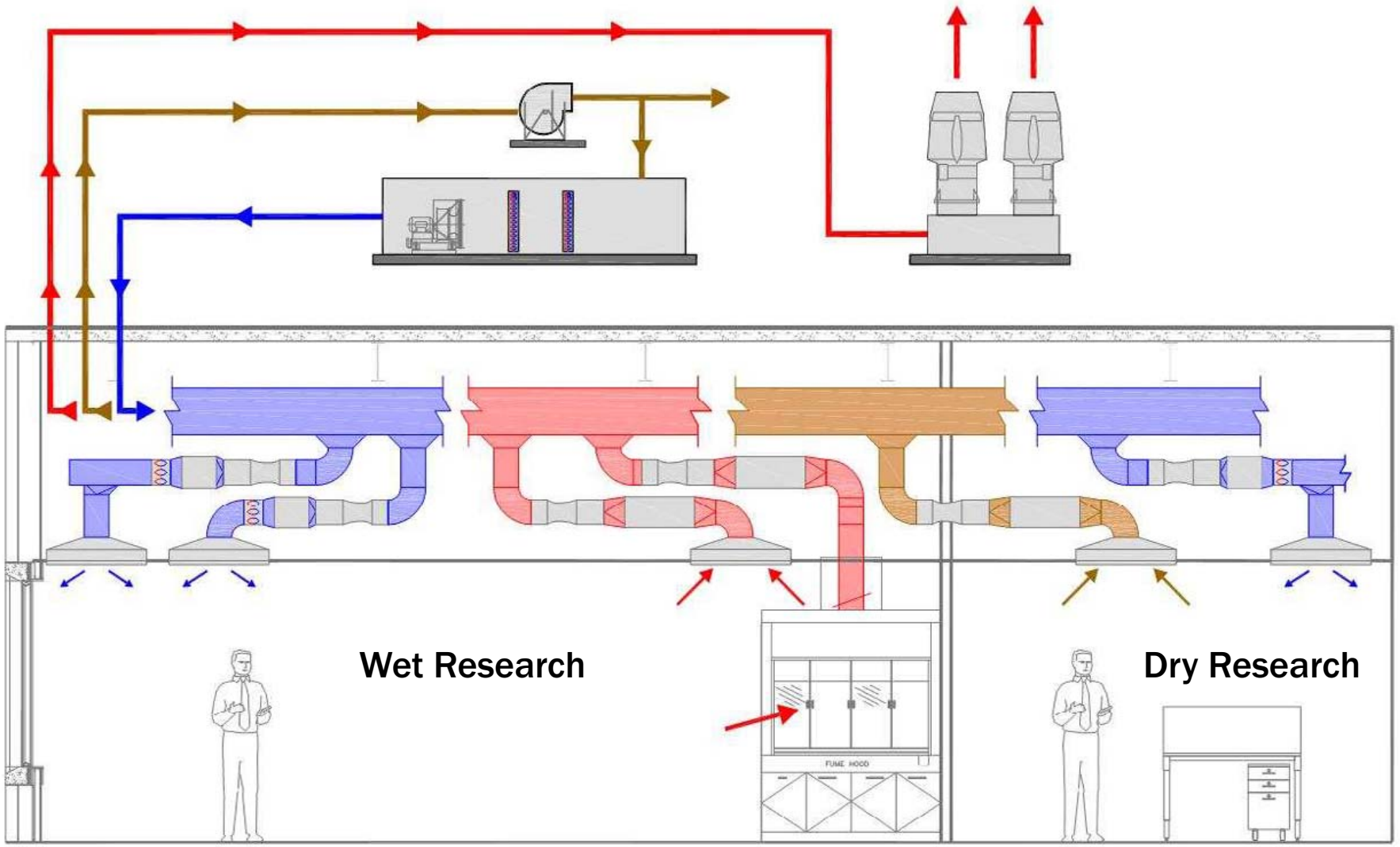
Minimum AC/Hr	6
Design Internal load	12w/sf
Ave. Internal Load	6w/sf

- **ALL WET RESEARCH IS CONSOLIDATED WITHIN LAB SUPPORT**
- **1 PI PER 1,400 SF**
- **DRY RESEARCH : WET RESEARCH = 2.5 : 1**

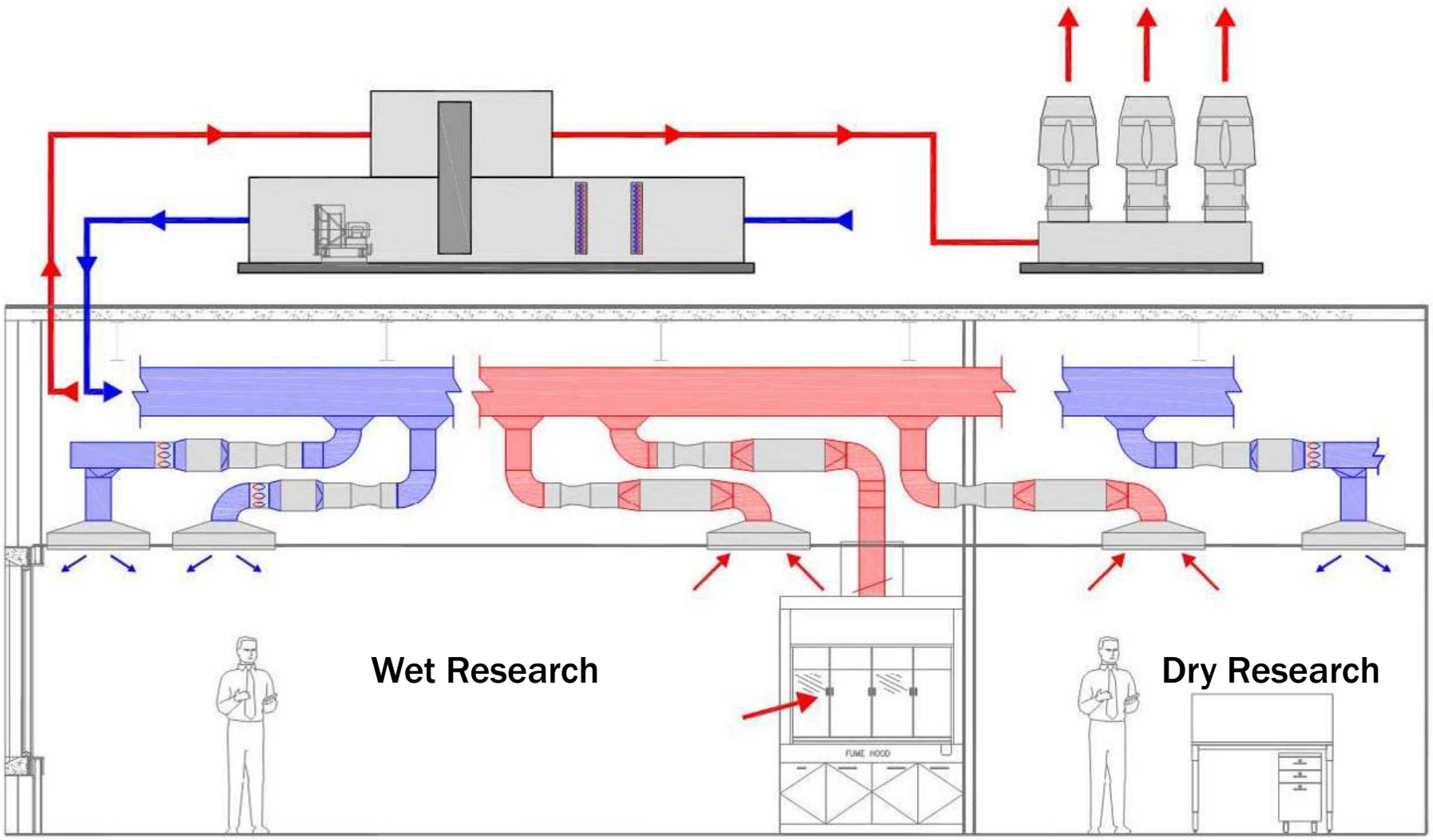
4 DUCT SYSTEM



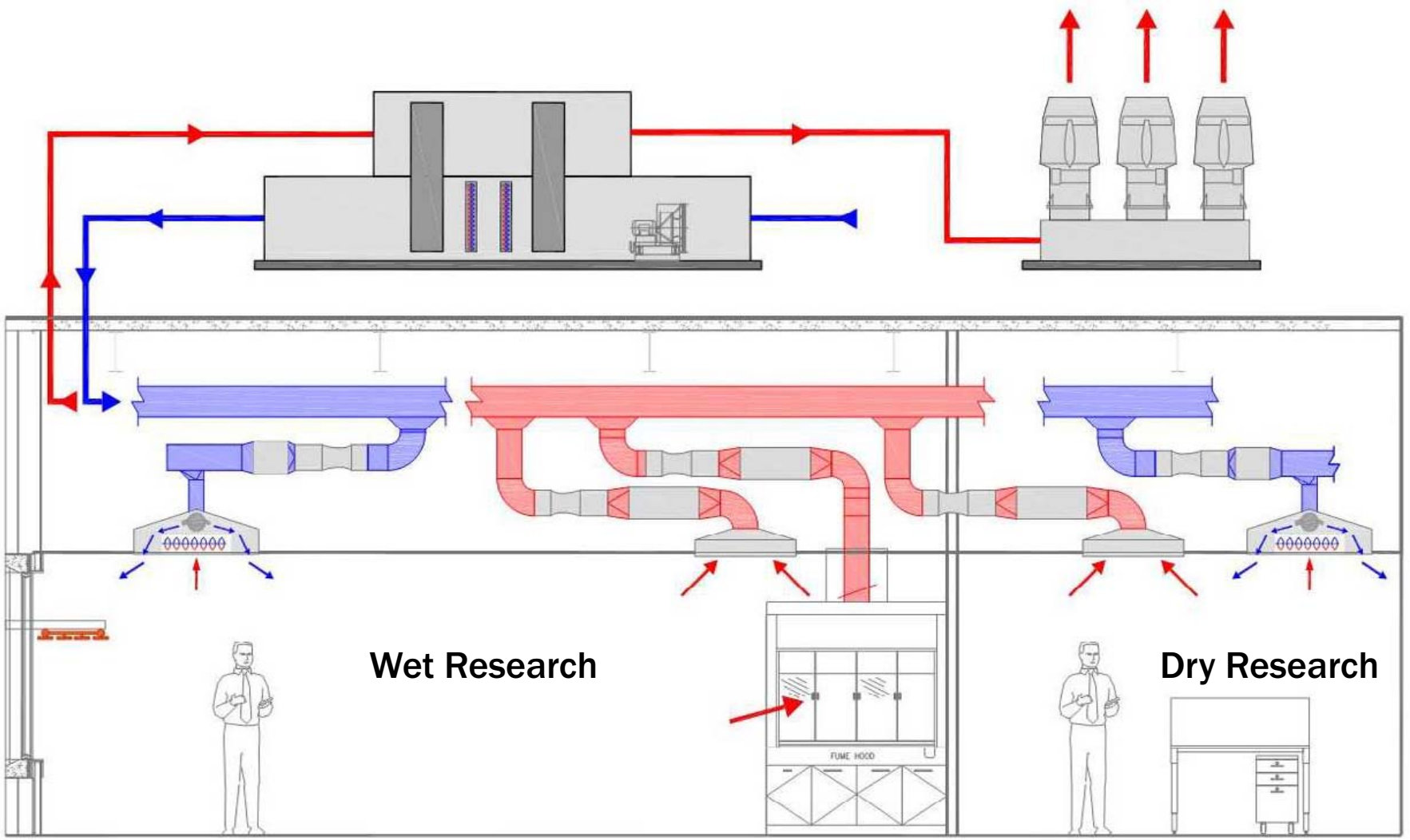
3 DUCT SYSTEM



2 DUCT VAV SYSTEM



2 DUCT HIGH PERFORMANCE CHILLED BEAM SYSTEM

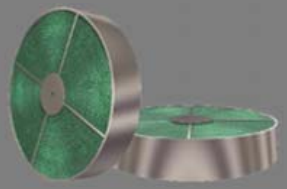


70% WET LAB MODULE | 2 Duct High Performance Chilled Beam System

AREA: (%)
Wet Lab: 35%
Support: 35%
Dry Lab: 20%
Offices: 10%

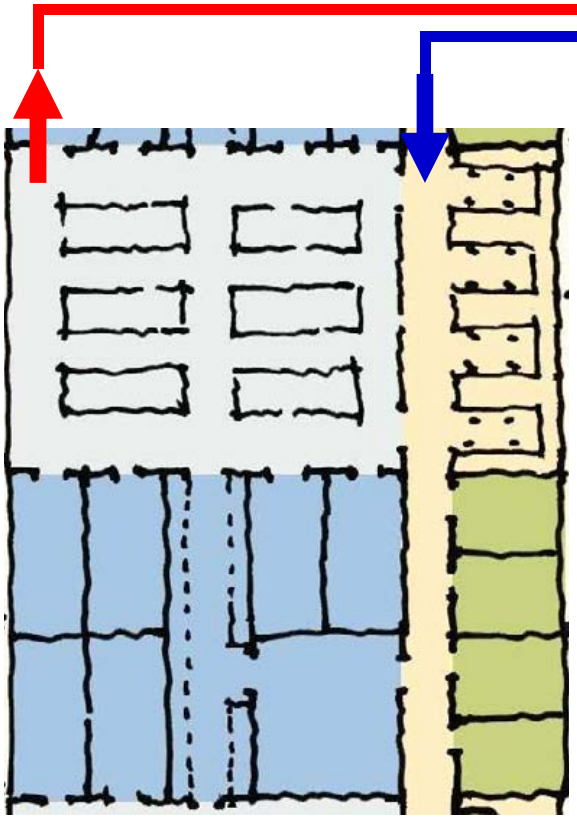
TECHNOLOGY:

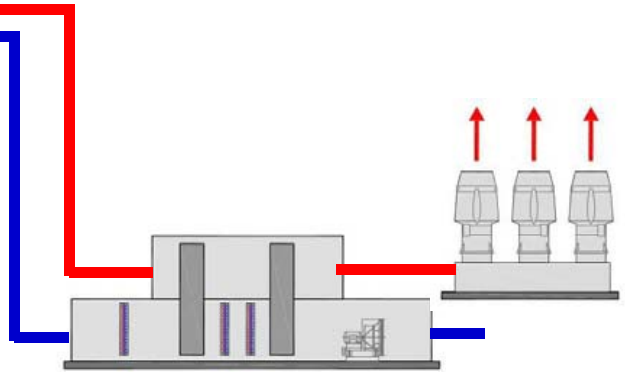
Venturi Valves (Labs)



Energy Recovery Wheel(s)

Chilled Beams



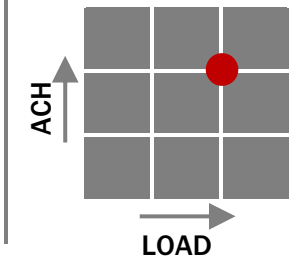


MODULE METRICS (5,400 NSF)	
Peak Dry Research CFM	800
Peak Wet Research CFM	4,000
Peak Cooling CFM	4,800
Peak Cooling Load (tons)	30

* Assumes 400 btu/lf perimeter solar/conduction load

HIGH

FLEXIBILITY



130

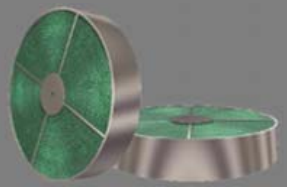
KBTU / GSF

50% WET LAB MODULE | 2 Duct High Performance Chilled Beam System

AREA: (%)
Wet Lab: 20%
Support: 30%
Dry Lab: 30%
Offices: 10%
Conference: 10%

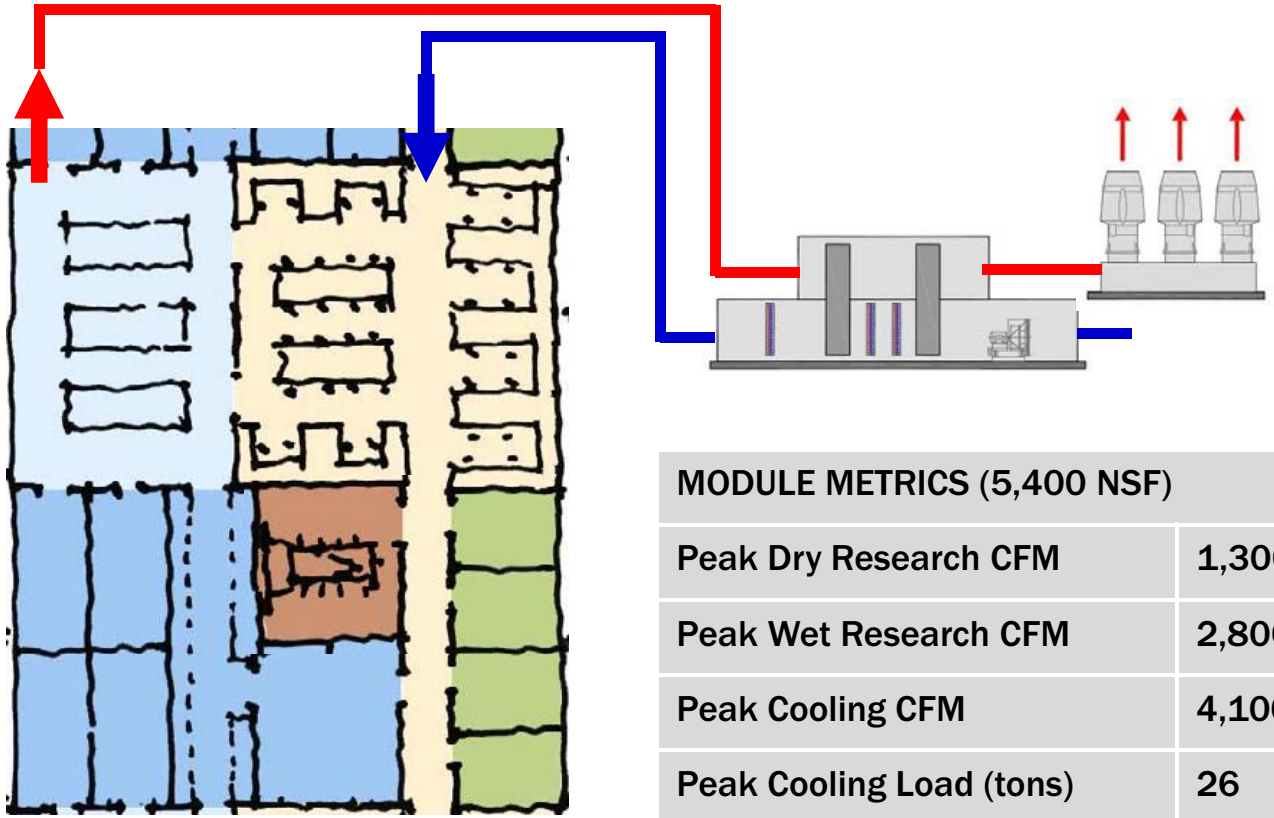
TECHNOLOGY:

Venturi Valves (Labs)



Energy Recovery Wheel(s)

Chilled Beams

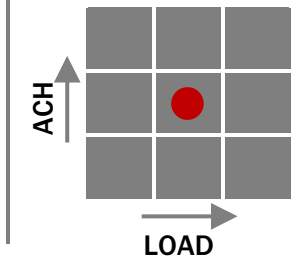


MODULE METRICS (5,400 NSF)	
Peak Dry Research CFM	1,300
Peak Wet Research CFM	2,800
Peak Cooling CFM	4,100
Peak Cooling Load (tons)	26

* Assumes 400 btu/lf perimeter solar/conduction load

HIGH

FLEXIBILITY



120

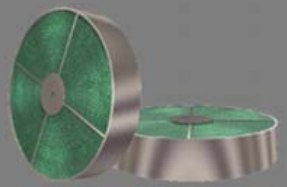
KBTU / GSF

20% WET LAB MODULE | 2 Duct High Performance Chilled Beam System

AREA: (%)
Conference: 20%
Support: 20%
Dry Lab: 50%
Offices: 10%

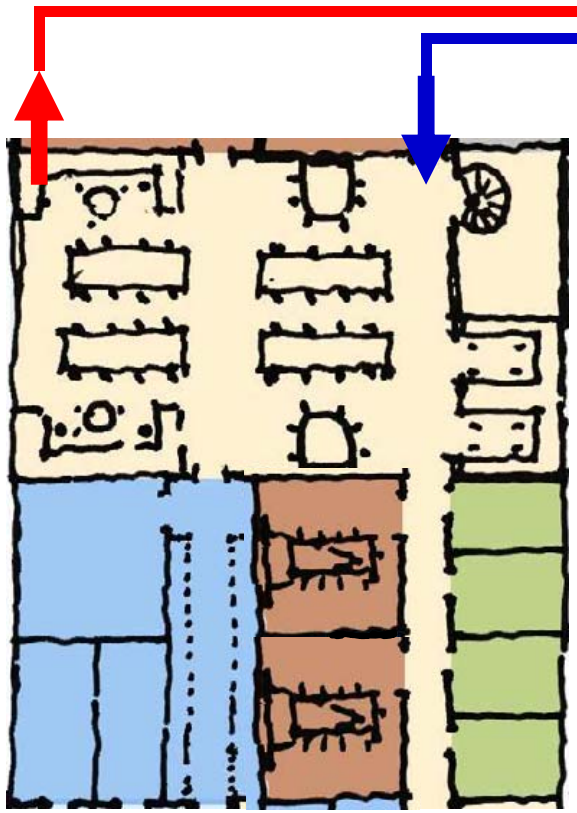
TECHNOLOGY:

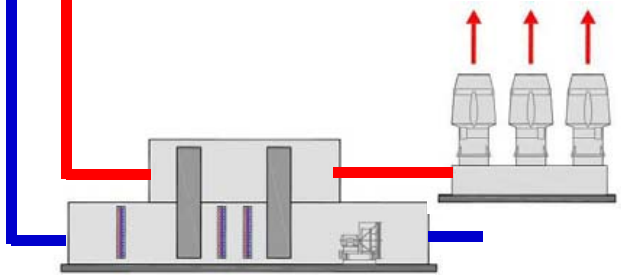
Venturi Valves (Labs)



Energy Recovery Wheel(s)

Chilled Beams



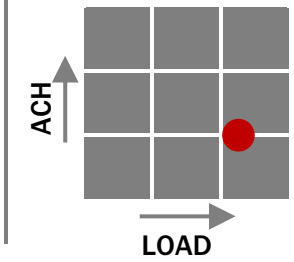


MODULE METRICS (5,400 NSF)	
Peak Dry Research CFM	2,100
Peak Wet Research CFM	1,200
Peak Cooling CFM	3,300
Peak Cooling Load (tons)	24

* Assumes 400 btu/lf perimeter solar/conduction load

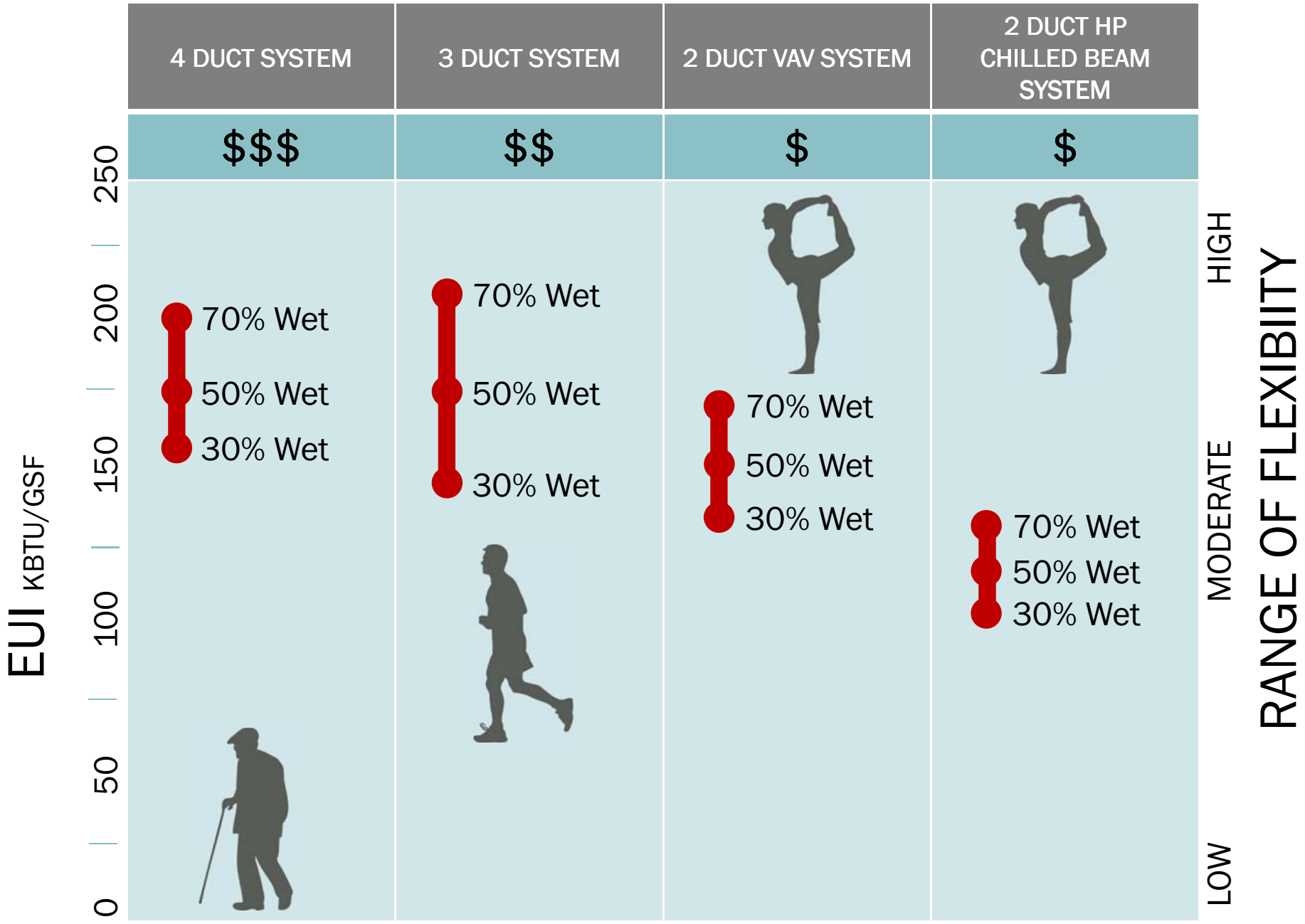
HIGH

FLEXIBILITY



110

KBTU / GSF


4 DUCT SYSTEM
3 DUCT SYSTEM
2 DUCT VAV SYSTEM
2 DUCT HP CHILLED BEAM SYSTEM
$$$
$$
$
$
EUI KBTU/GSF
250
200
150
100
50
0
70% Wet
50% Wet
30% Wet
70% Wet
50% Wet
30% Wet
70% Wet
50% Wet
30% Wet
70% Wet
50% Wet
30% Wet
HIGH
MODERATE
LOW
RANGE OF FLEXIBIITY

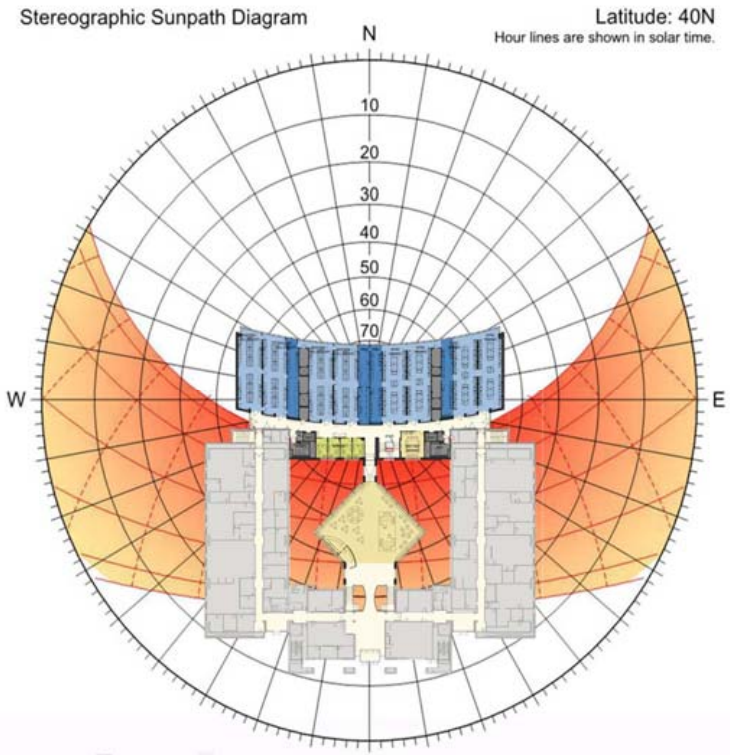
JOHNS HOPKINS UNIVERSITY

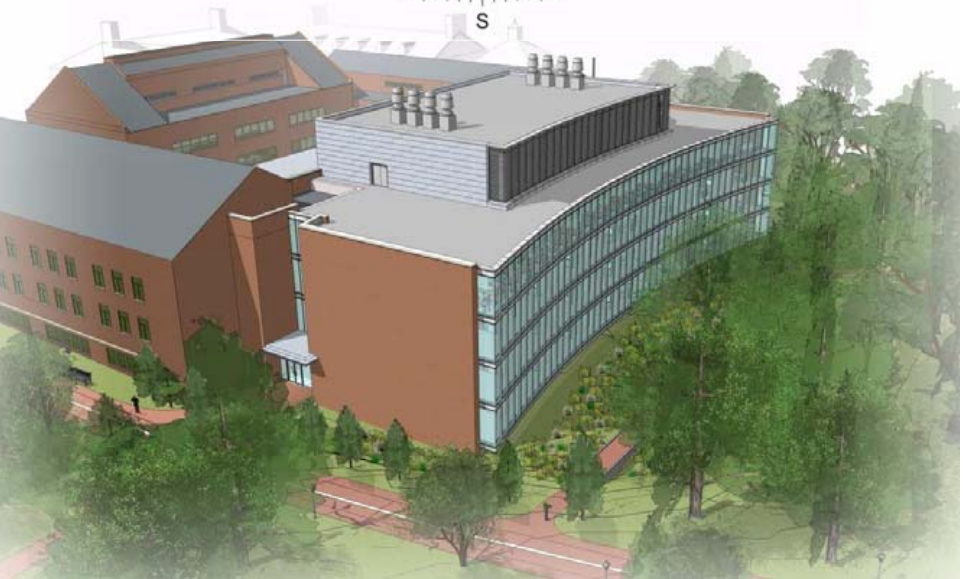
Undergraduate Teaching Lab

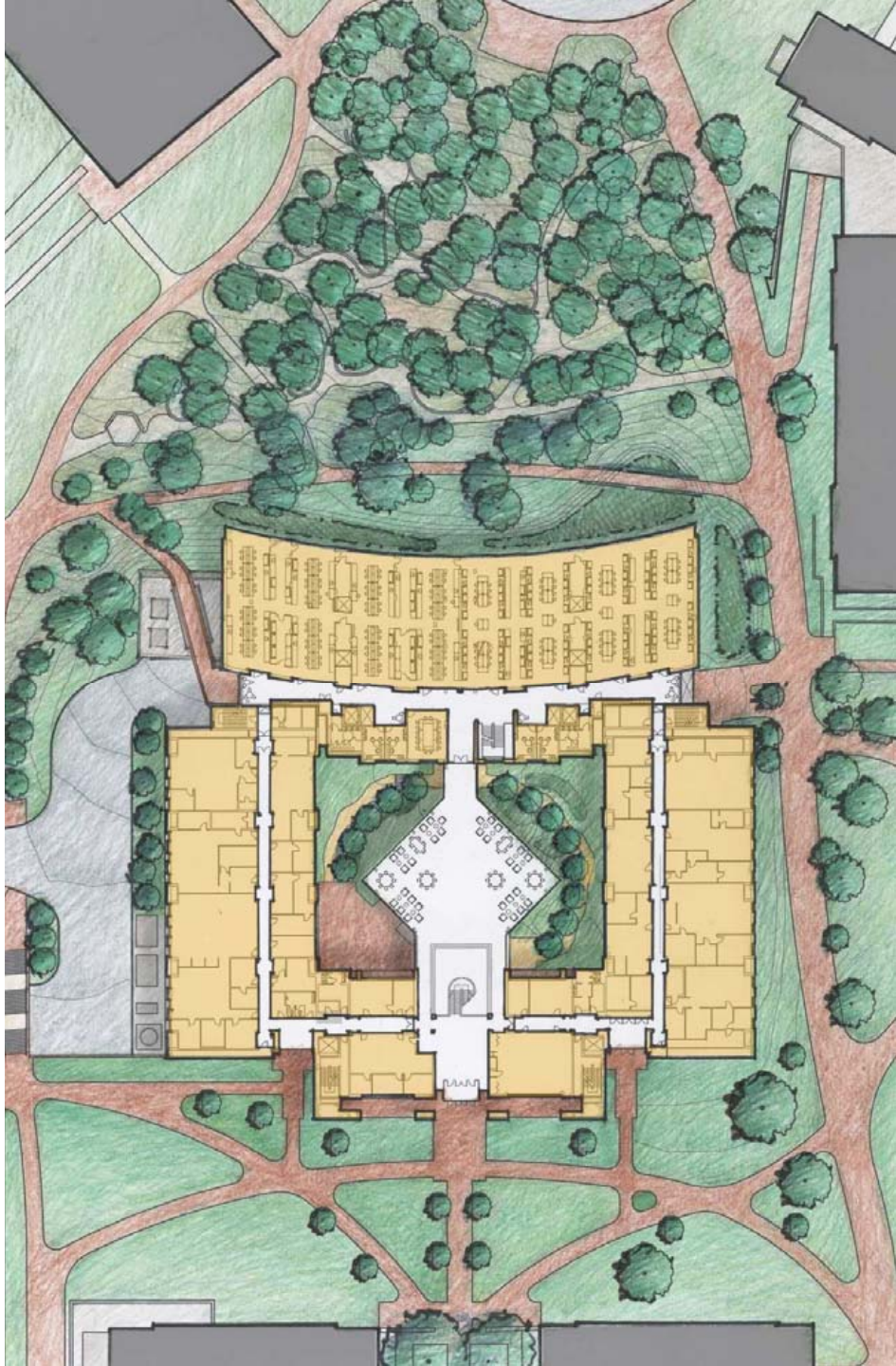
BALLINGER

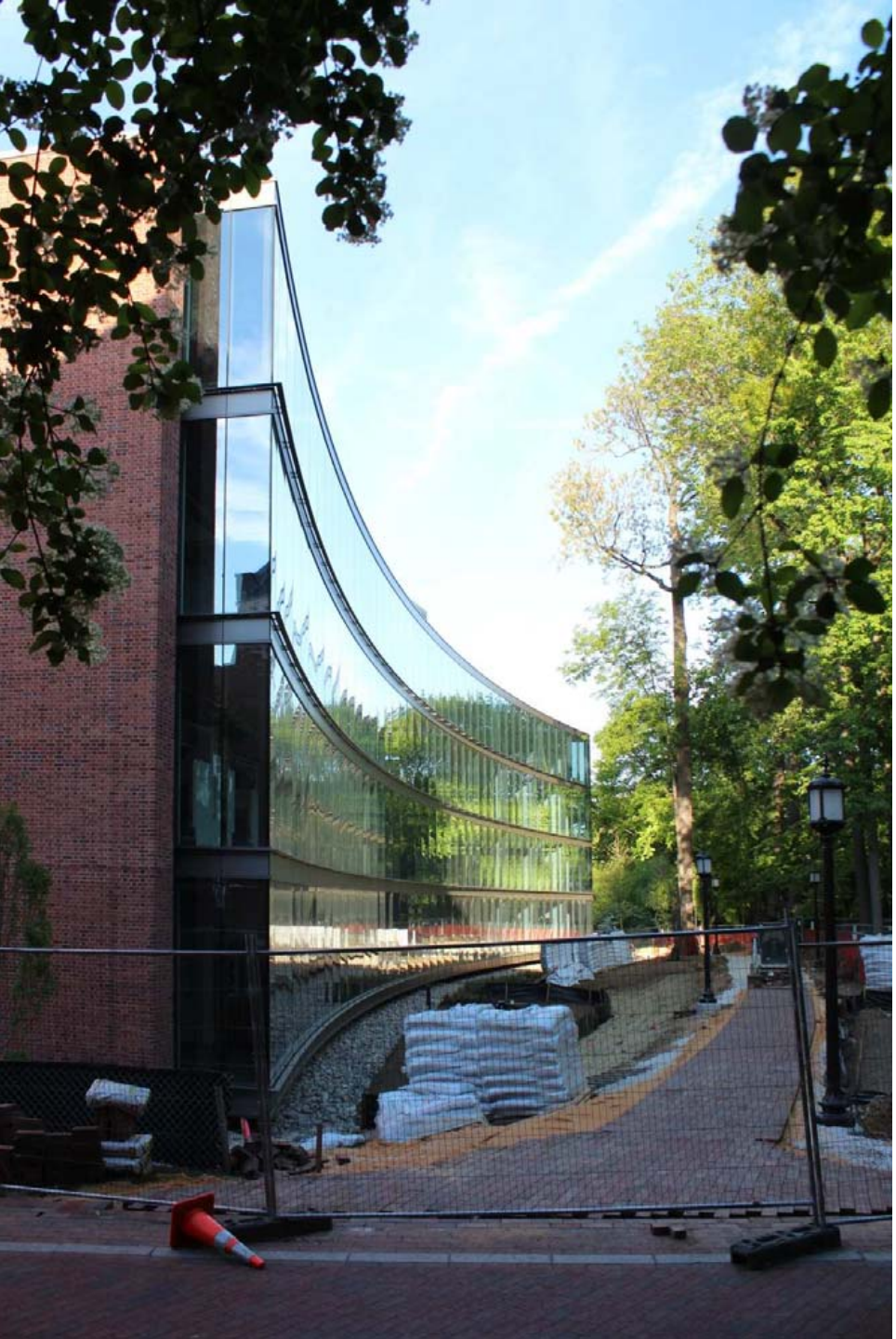
105,000 GSF | 2013

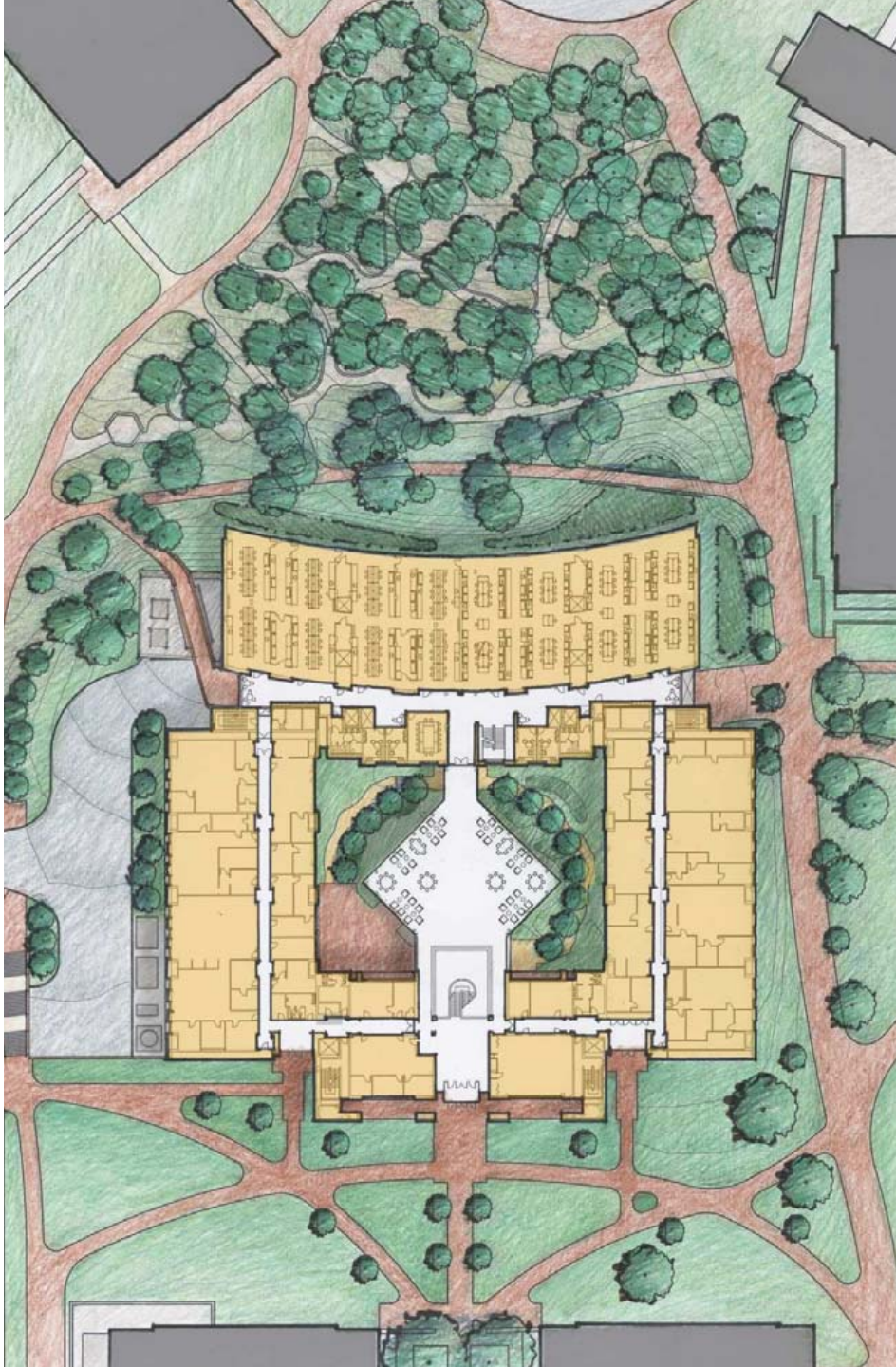
SITE AND SOLAR ORIENTATION









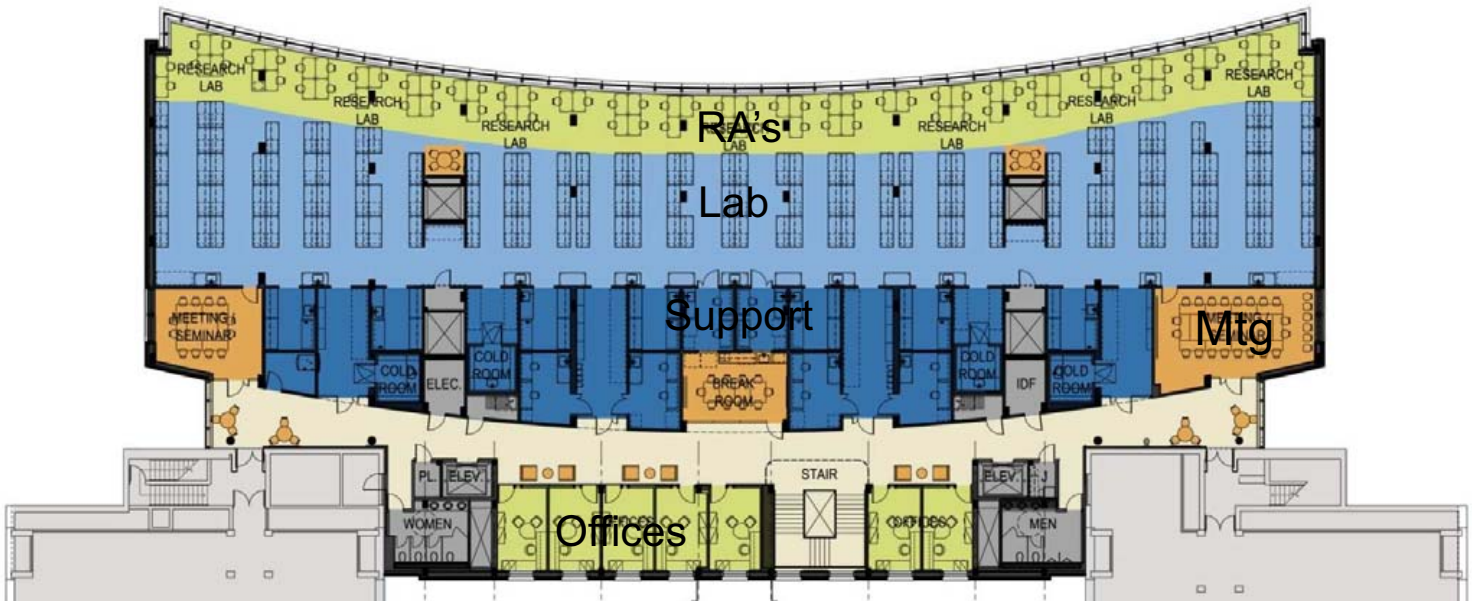


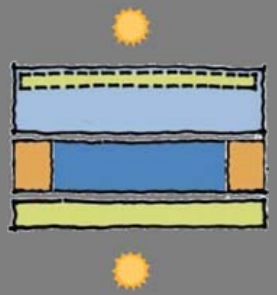
JOHNS HOPKINS UNIVERSITY UNDERGRADUATE TEACHING LAB Typical Research Floor

Traditional Metrics and Factors

Area:
GSF: 20,157 sf
NSF: 15,506 sf
Efficiency: 77%
2,215 NSF/PI

Density:
85 FTE/floor
237 GSF/FTE
182 NSF/FTE
65% Wet
17 LF eq. / FTE





JOHNS HOPKINS UNIVERSITY UNDERGRADUATE TEACHING LAB Typical Research Floor

Traditional Metrics and Factors

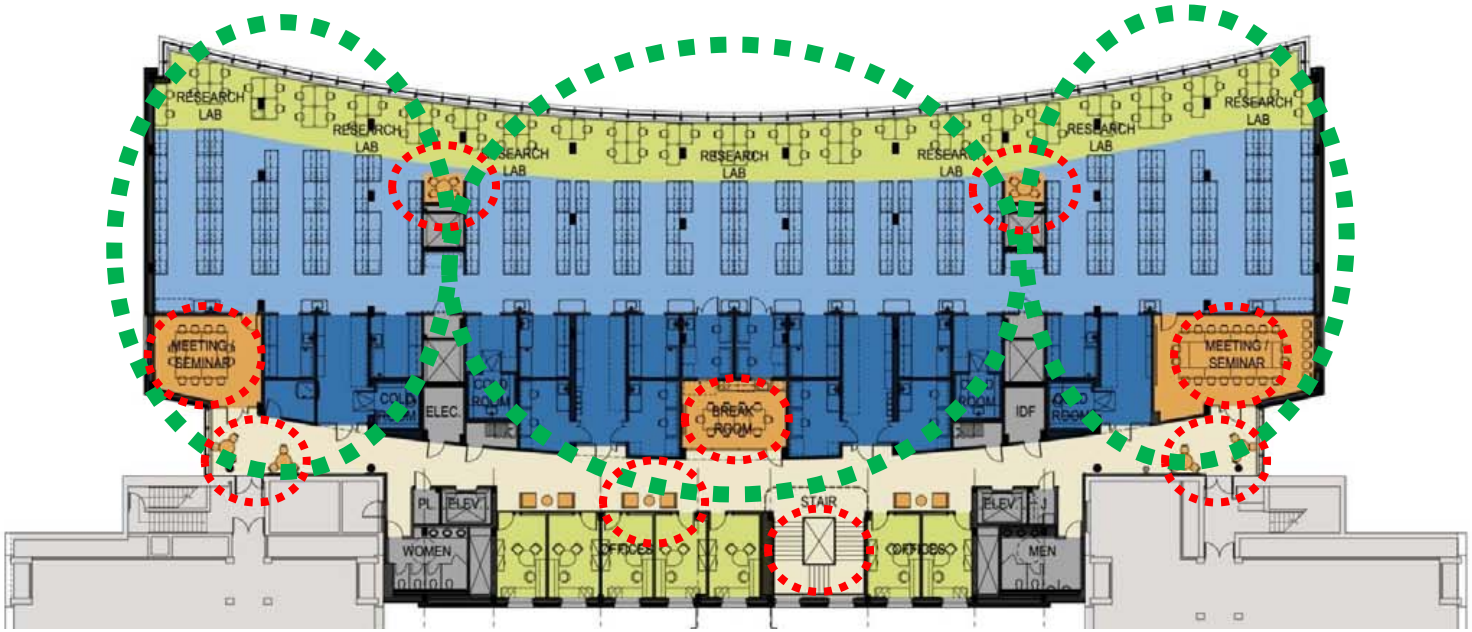
Area:
GSF: 20,157 sf
NSF: 15,506 sf
Efficiency: 77%
2,215 NSF/PI

Density:
85 FTE/floor
237 GSF/FTE
182 NSF/FTE
65% Wet
17 LF eq. / FTE

New Metrics

Draws: 9 Total
Meeting: 4
Kitchenette: 1
Open Stair: 1
Open Seating: 3

Spatial Neighborhoods:
3 Total



46%
Interaction Seats

1/85
Food & Coffee/FTE

28
FTE/Spatial Neighborhood

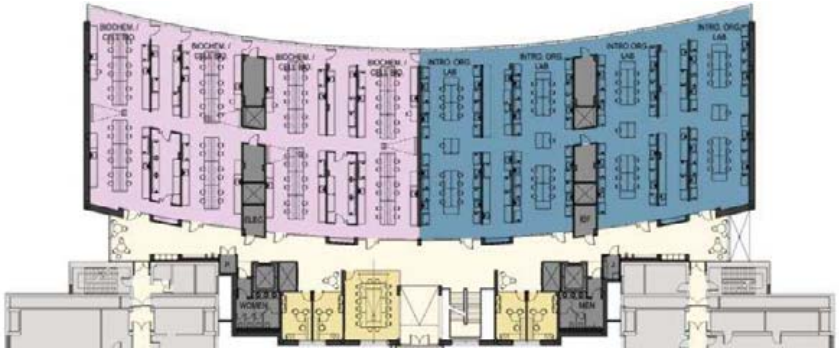
1/9
Draws/FTE

9
Average FTE/Room

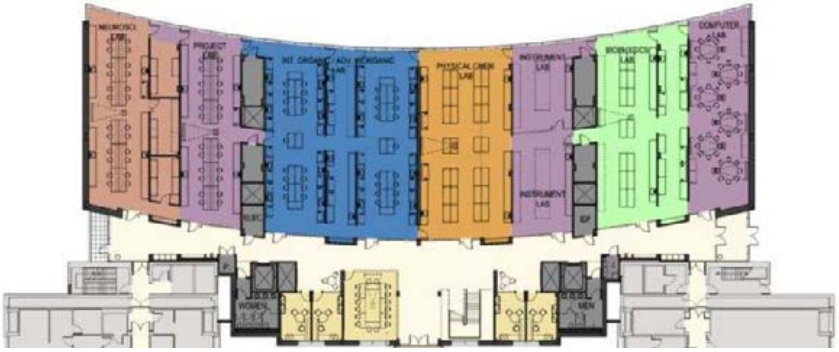
TEACHING LAB FLOOR PLANS

2

1

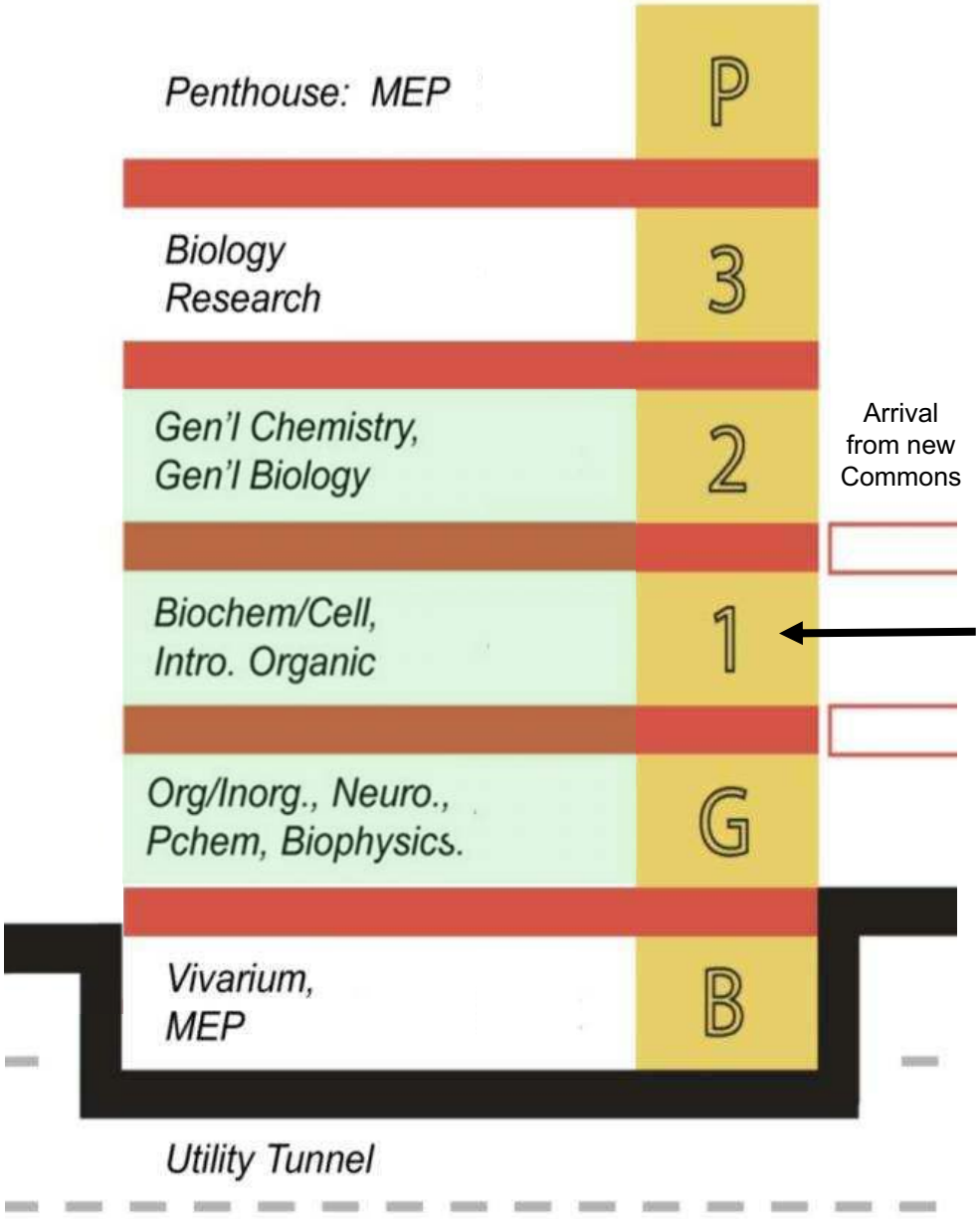


G



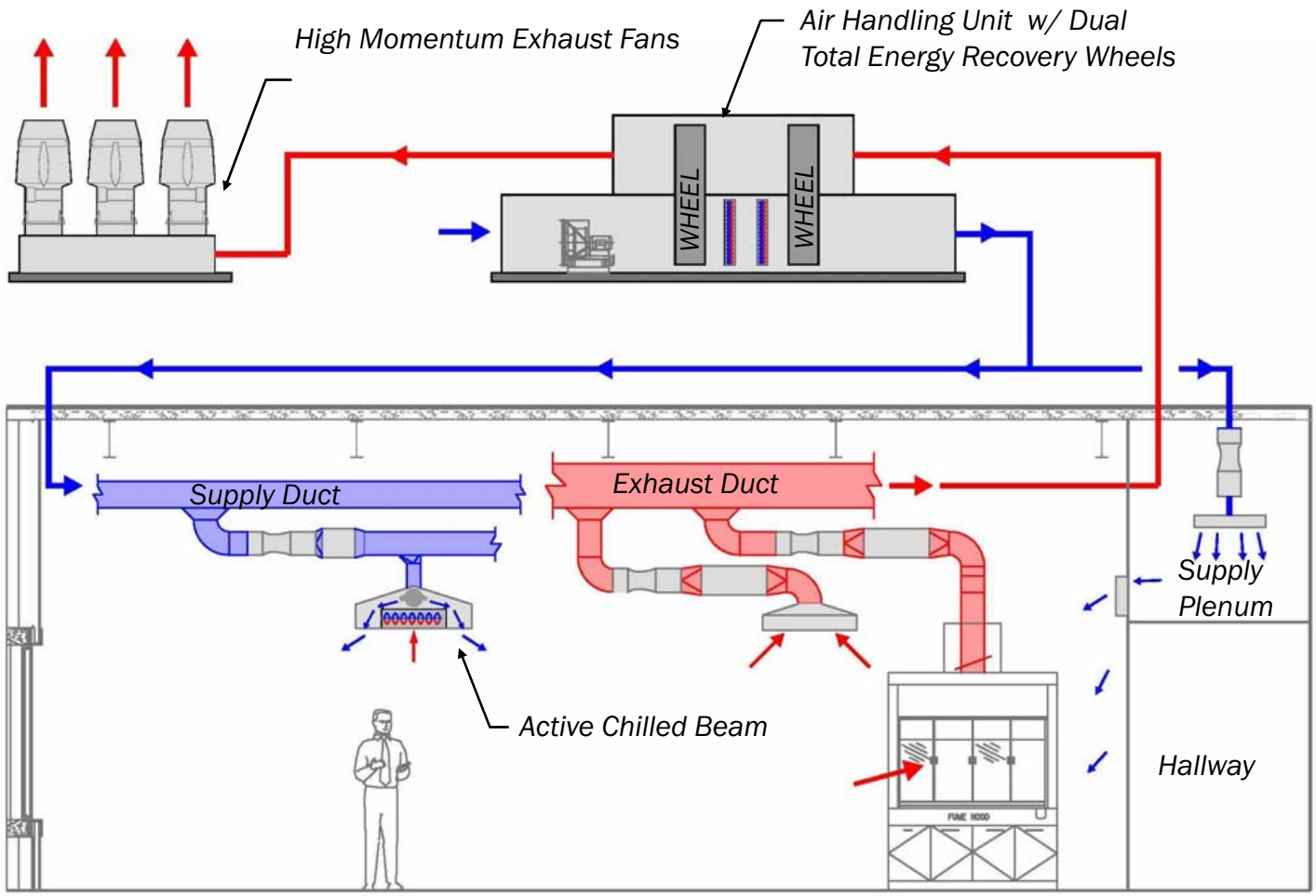

Air
SENTRY

PROGRAM STACK



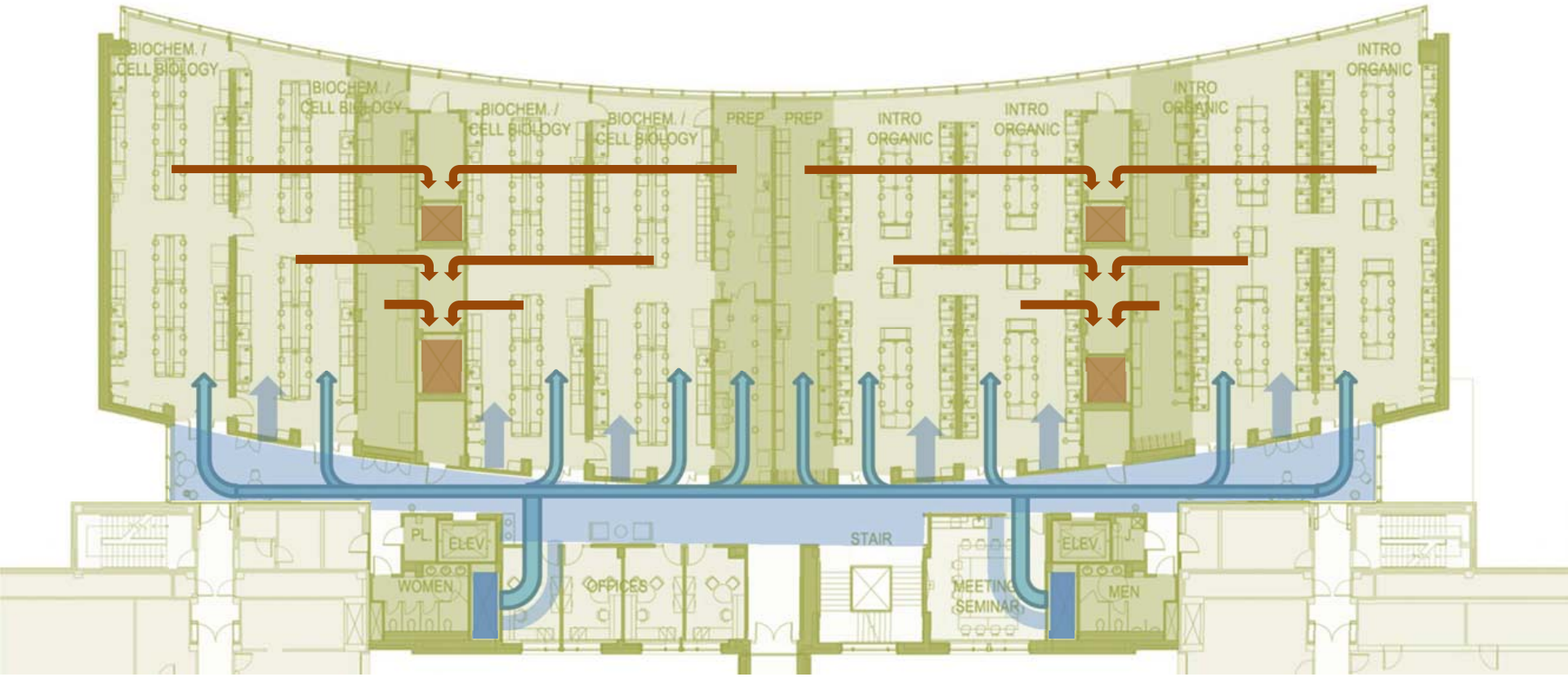

EXIT
EXIT

NEUTRAL AIR / ACTIVE CHILLED BEAMS / PLENUM SUPPLY



- Active chilled beams
- Chilled water (58°F) to chilled beams
- 3A molecular sieve total energy recovery
- Reheat energy recovery wheel
- High performance fume hoods
- Supply plenum to deliver neutral temperature makeup air

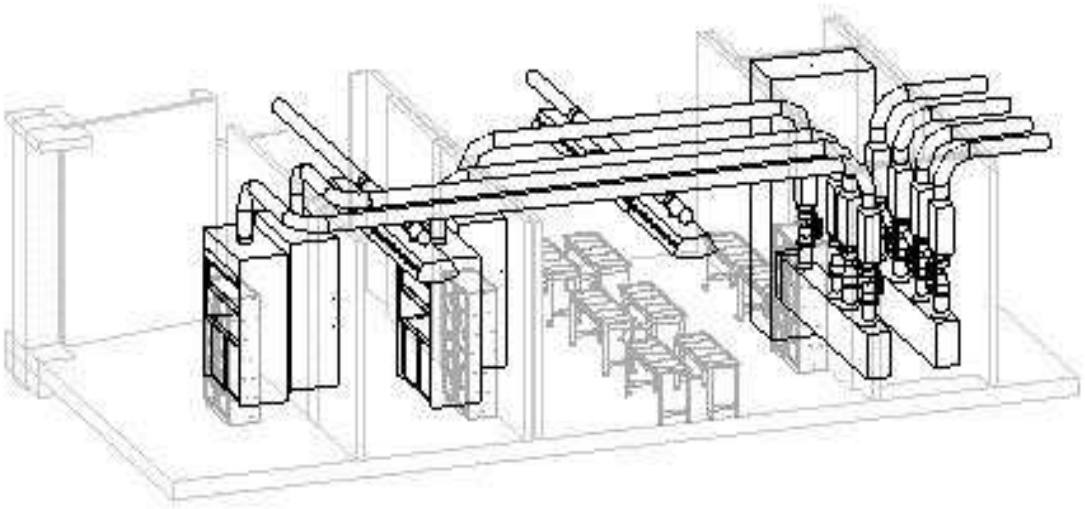
MECHANICAL DISTRIBUTION: CONCEPTUAL STRATEGY



	All Air Ducted Supply Air CFM (55F)	High Performance Ducted Supply Air CFM (neutral)
Biology Teaching: *(8) 6' Fumehoods*	3,900(1.2 CFM/SF)	2,500 (0.8 CFM/SF)
Chemistry Teaching: *(32) 4' Fumehoods*	10,240 (fumehood driven)	2,500(0.8 CFM/SF)
Biology Research: *(5) 6' Fume Hoods*	4,800(1.5 CFM/SF)	2,800 (0.9 CFM/SF

Typical 3,200 sf Laboratory/Classroom Module: 4 per Floor

HVAC DISTRIBUTION STRATEGY: VENTURI VALVE GALLERY



Venturi Valve Gallery Serving 3,200 sf Module:

- Low Floor to Floor Strategy
- Easy Access
- Separates User and Operations Personnel

TOTAL QUALITY METRICS

EFFICIENCY METRICS

Construction value and return on investment.

NEW INTERACTION METRICS

Foster collaborative and convergent science.

SUSTAINABILITY ++

Energy Efficiency + **Adaptability**

THE NEW RESEARCH VALUE METRICS: INTERACTION | SUSTAINABILITY | PERFORMANCE

CONTINUUM OF RESEARCH + DEVELOPMENT

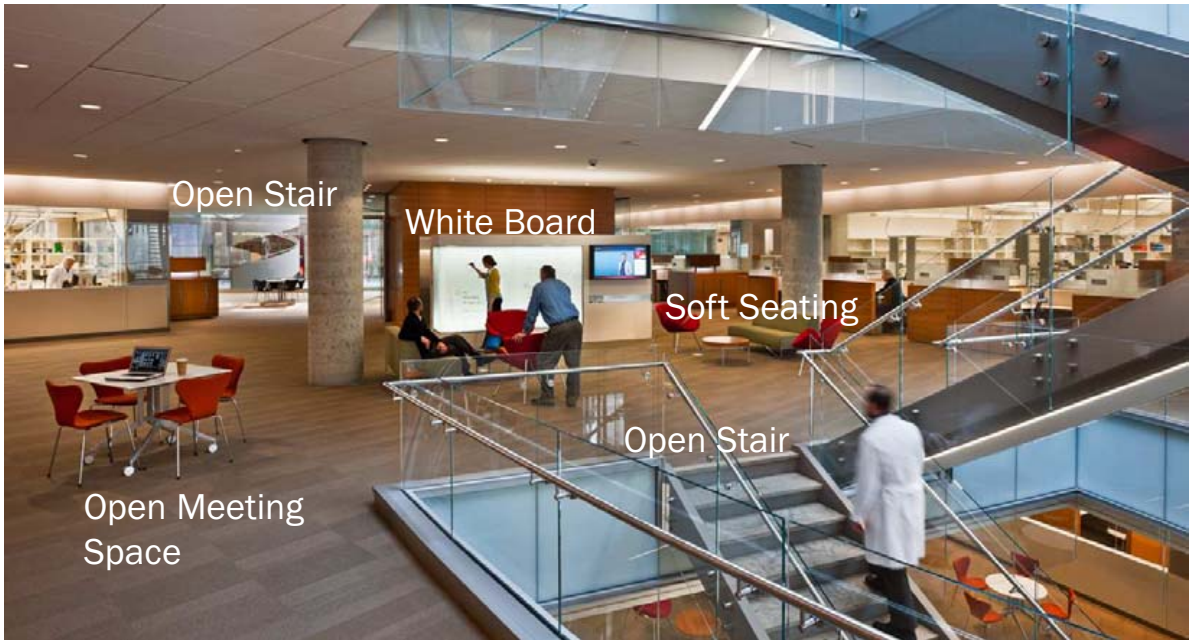
Thomas Edison Systemizes Research 1890-1930

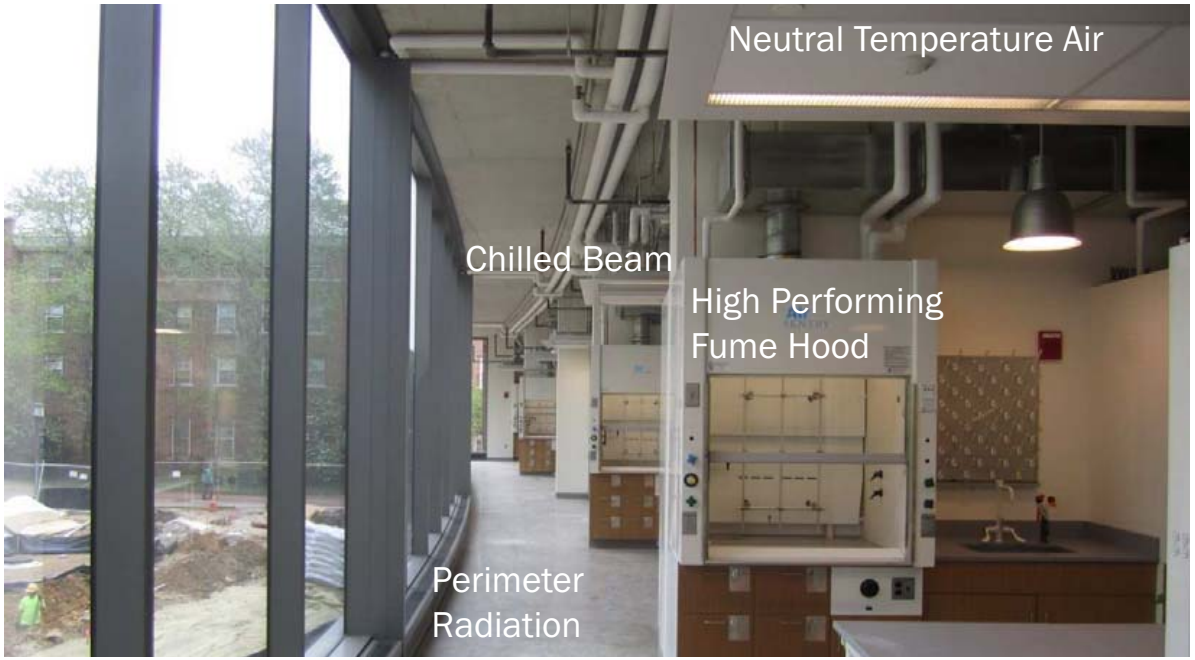
Francis Crick + James Watson Discover Double Helix 1953

Genome Mapped Francis Collins 1987 - 2003

Tom Allen Studies Research Organizations 1970 - 2010

A BRIEF HISTORY OF INNOVATION





TRADITIONAL METRICS

- Efficiency Net/Gross
- Lab / Lab Support Ratio
- Linear Foot of Bench / Researcher
- $/SF Productivity Measures

NEW METRICS

- Interaction Predictors
- Space & Systems Convertibility / Flexibility
- Low Energy Use / EUI

POST OCCUPANCY RESEARCH