PLANNING FOR SUCCESS

STEM Facilities




TREANORHL

AGENDA

1. Understanding the issues

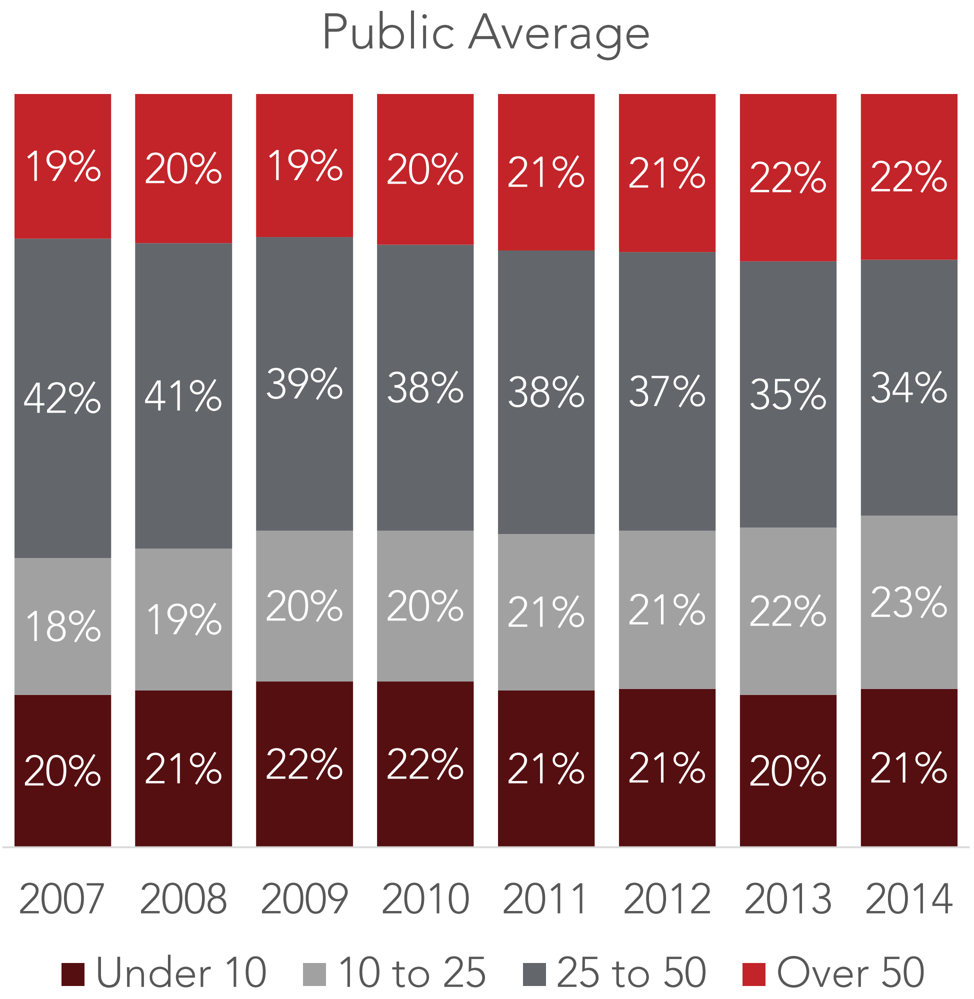
2. Planning & Programming Process

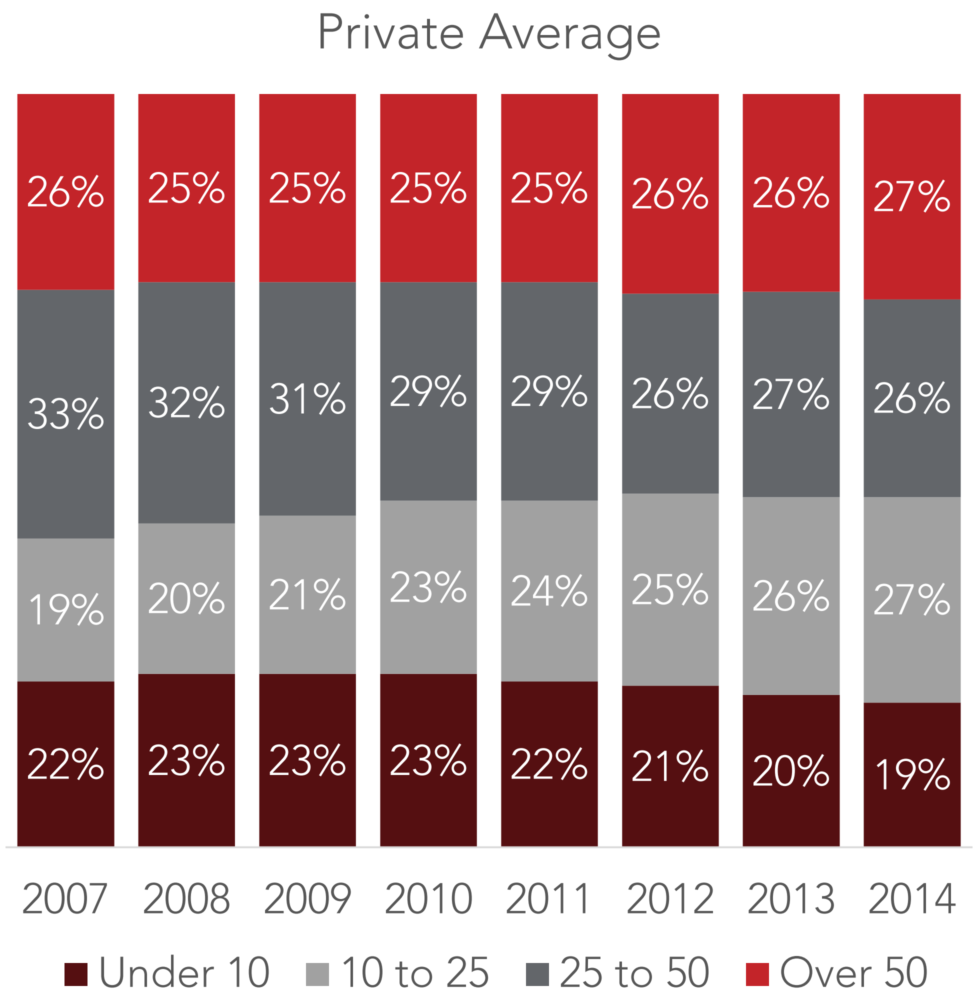
3. Trends

1.

Understanding the issues

Aging Higher Education Facilities

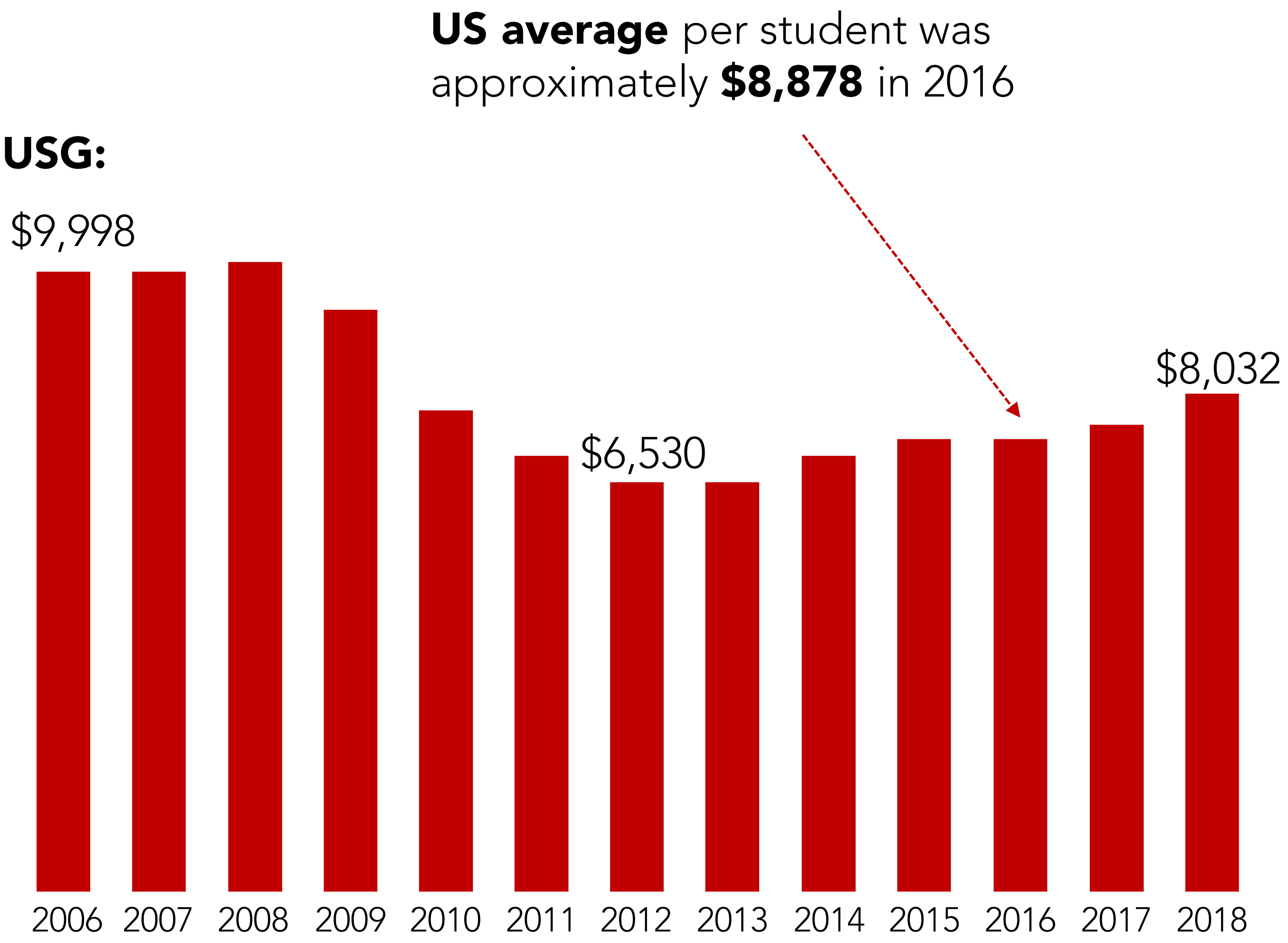




Source: Sightlines: STATE OF FACILITIES IN HIGHER EDUCATION – 2015 Benchmarks, Best Practices & Trends

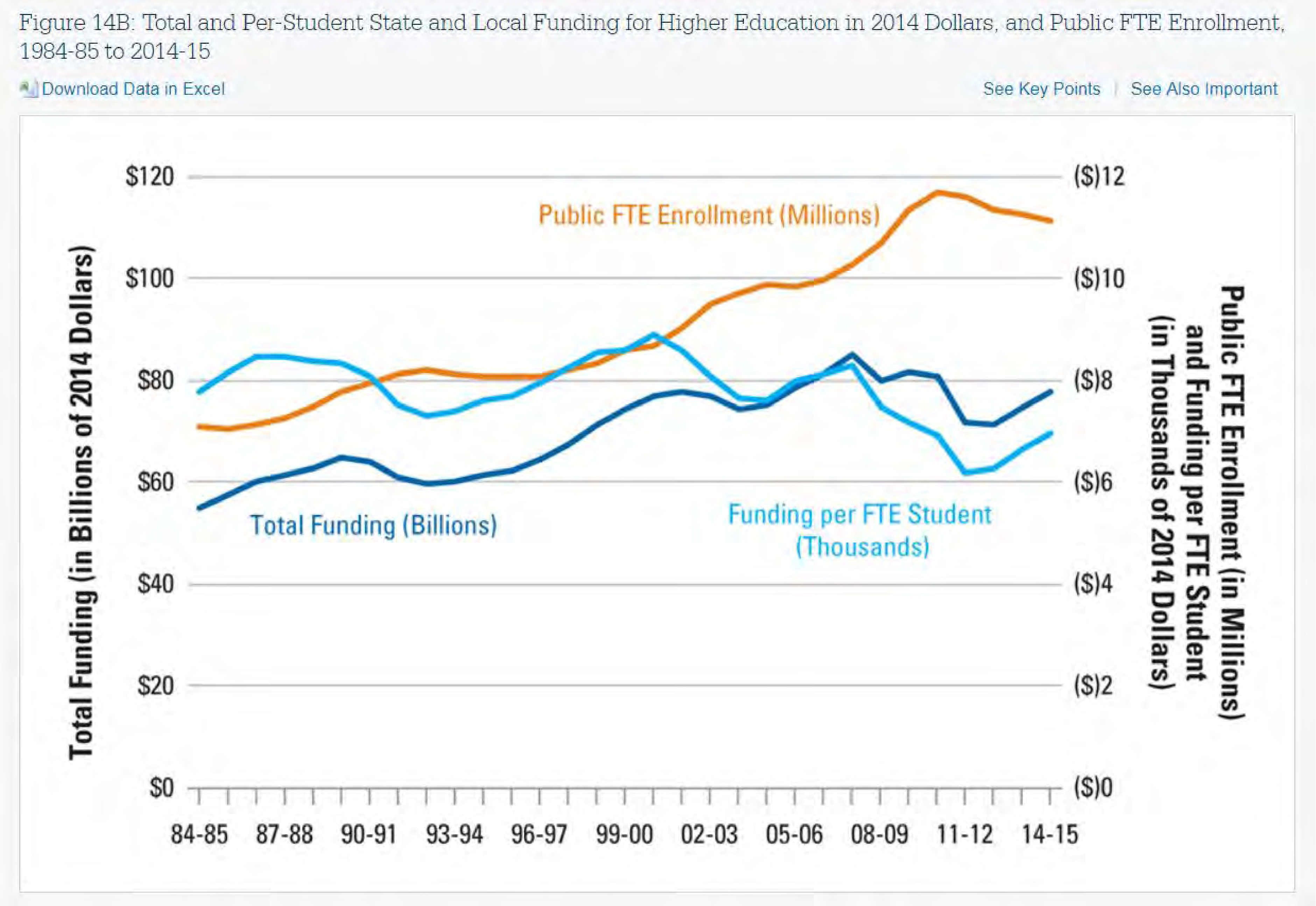
Funding decline

Most states provide less money per student now than before the last recession



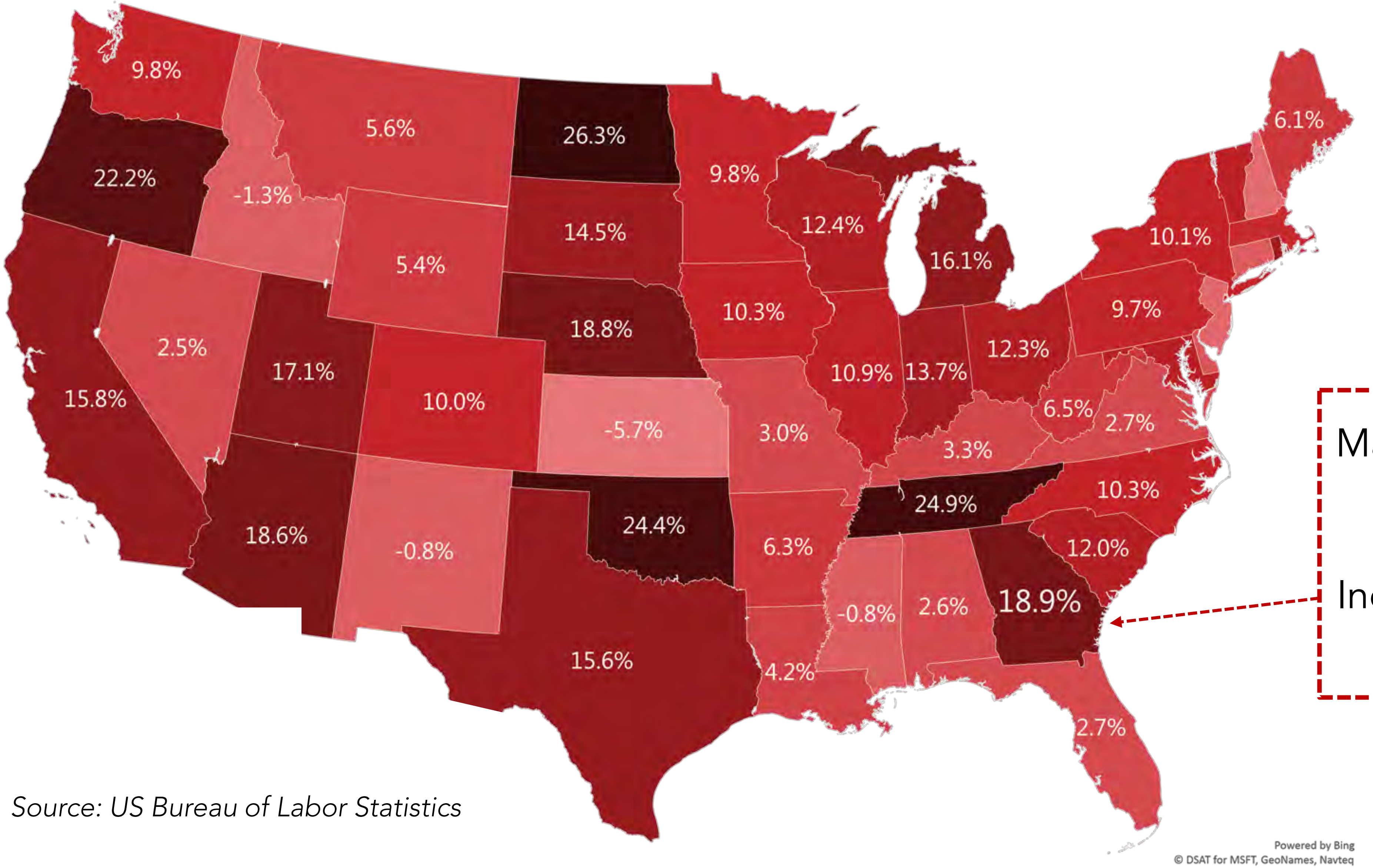
Source: https://gbpi.org/2017/georgias-education-cuts-a-growing-burden-for-low-income-students/
Georgia's amended budgets 2001-2017; 2018 budget (HB44), as signed by governor; University System of Georgia, fall semester enrollment reports 2001-2016, GBPI estimates of fall enrollment 2017 and 2018; adjusted for inflation; student is full-time equivalent

Enrollment trends



https://trends.collegeboard.org/college-pricing/figures-tables/total-and-student-state-and-local-funding-and-public-enrollment-over-time

STEM jobs

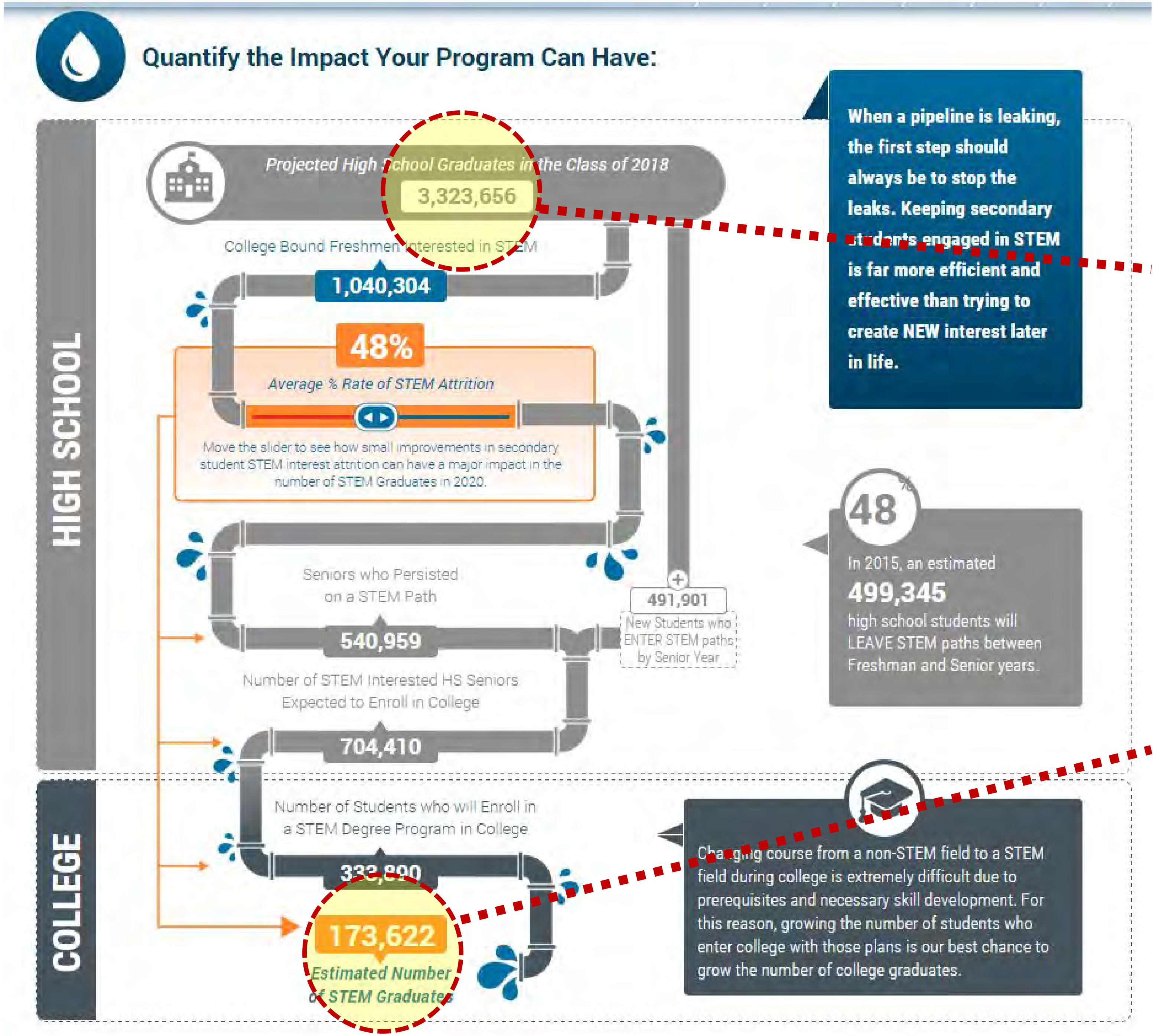


May 2009 – May 2015

18.9%

Increase in STEM jobs in Georgia

Source: US Bureau of Labor Statistics



National STEM pipeline

High school graduates:

2005: 2,799,250

2018: 3,323,656

+ 524,406 18%

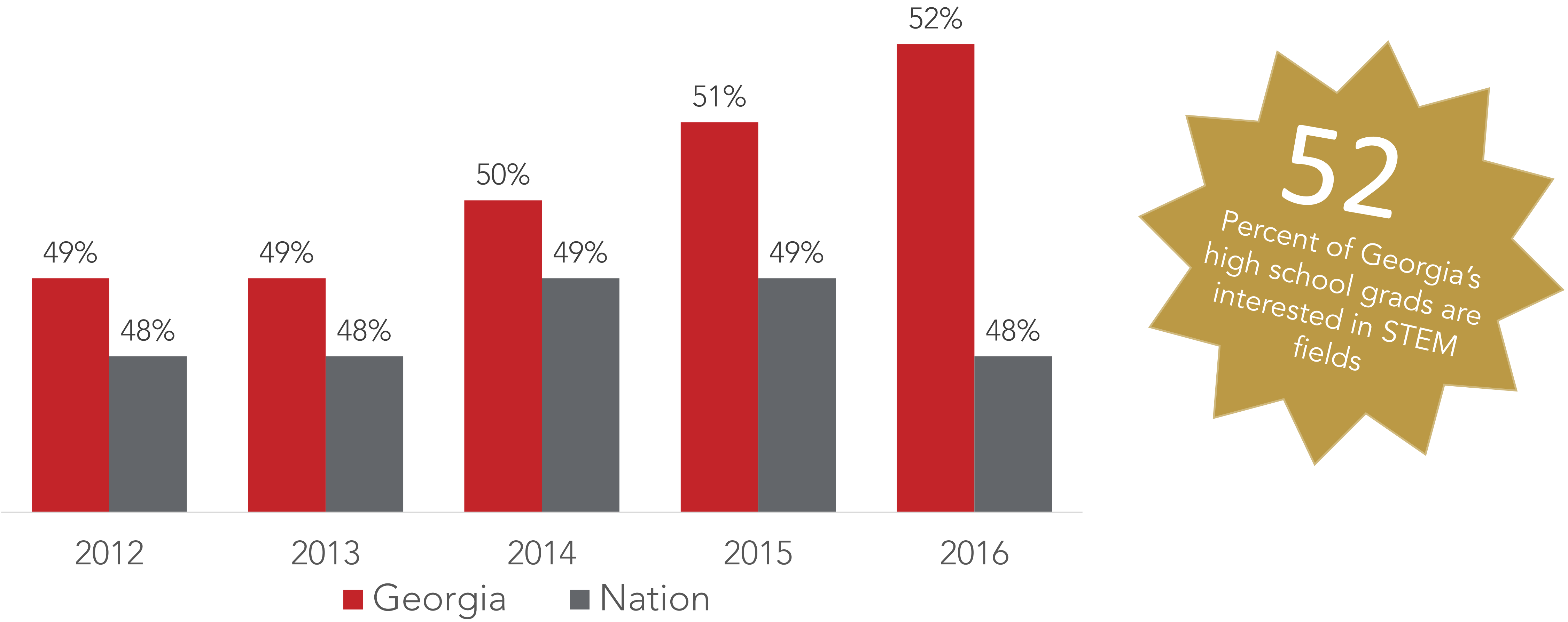
College STEM graduates:

2011: 166,530

2024: 173,622

+ 7,092 4%

STEM interest: 2012-2016

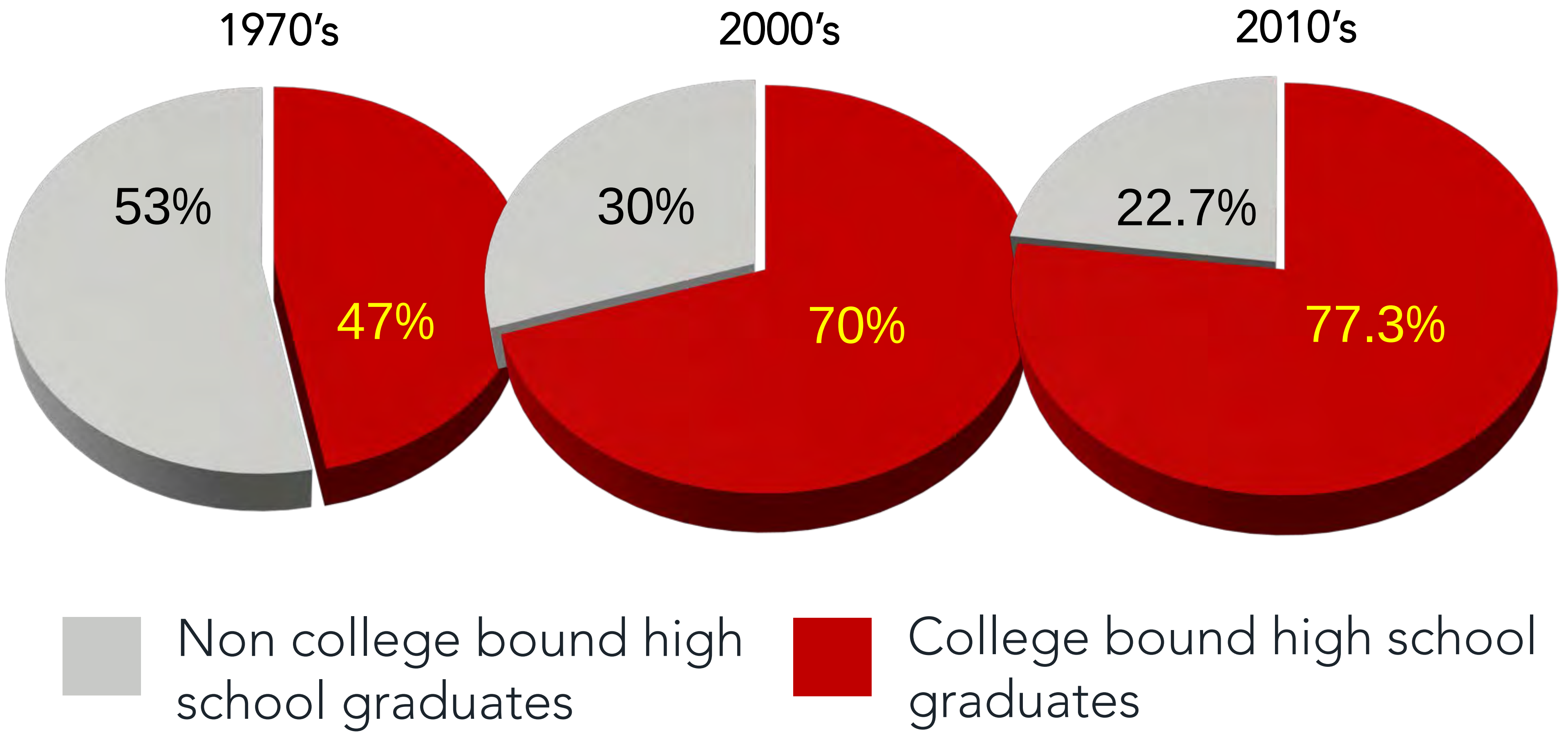


Source: ACT "The Condition of STEM" State Report - Georgia", 2016

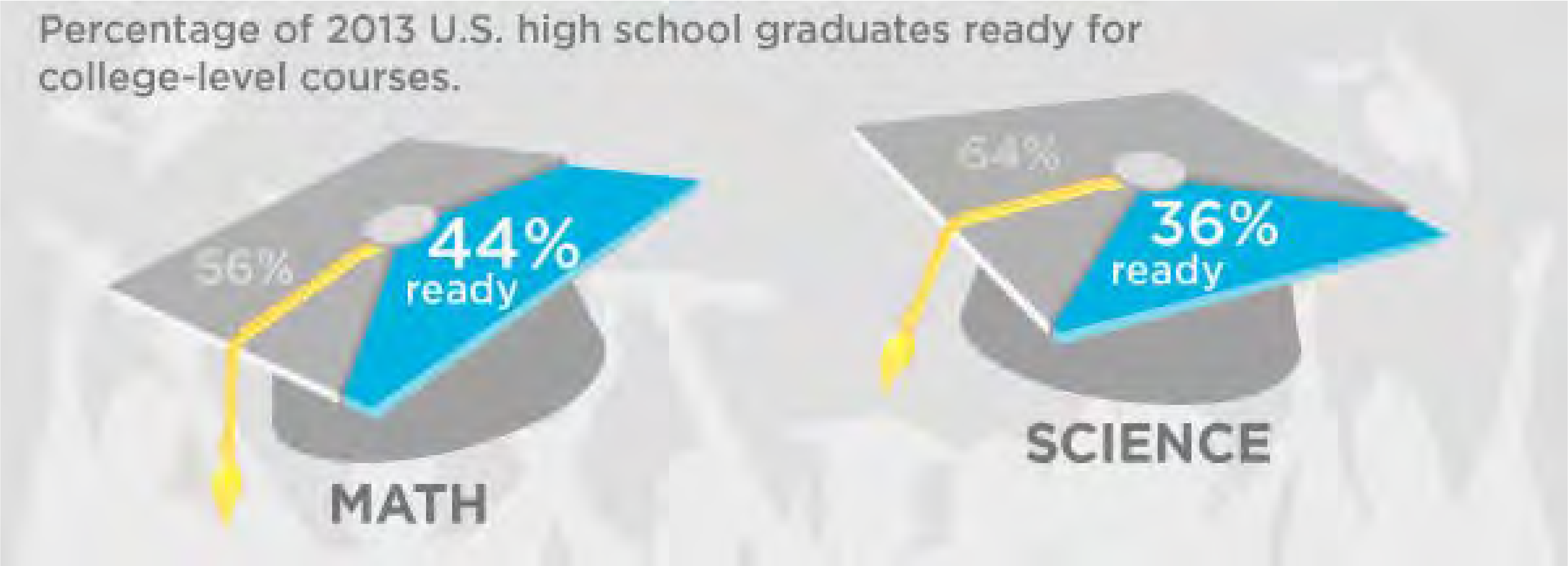
Students have changed...

"It's called 'reading'. It's how people install new software into their brains"

Students are more diverse

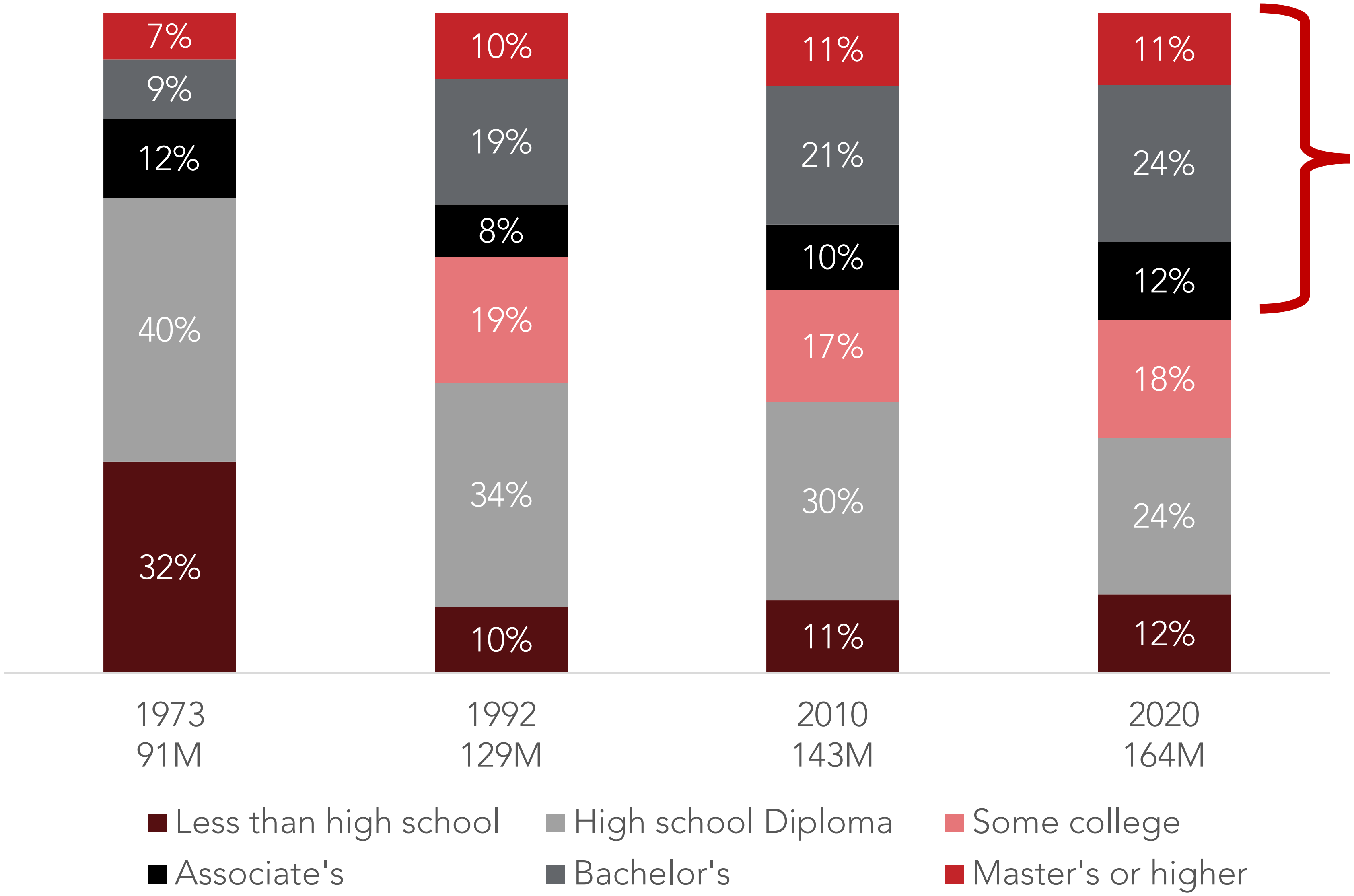


College readiness



NATIONAL MATH + SCIENCE INITIATIVE

Education demands



In 2020
47%
of all jobs require Associate's Degree or higher

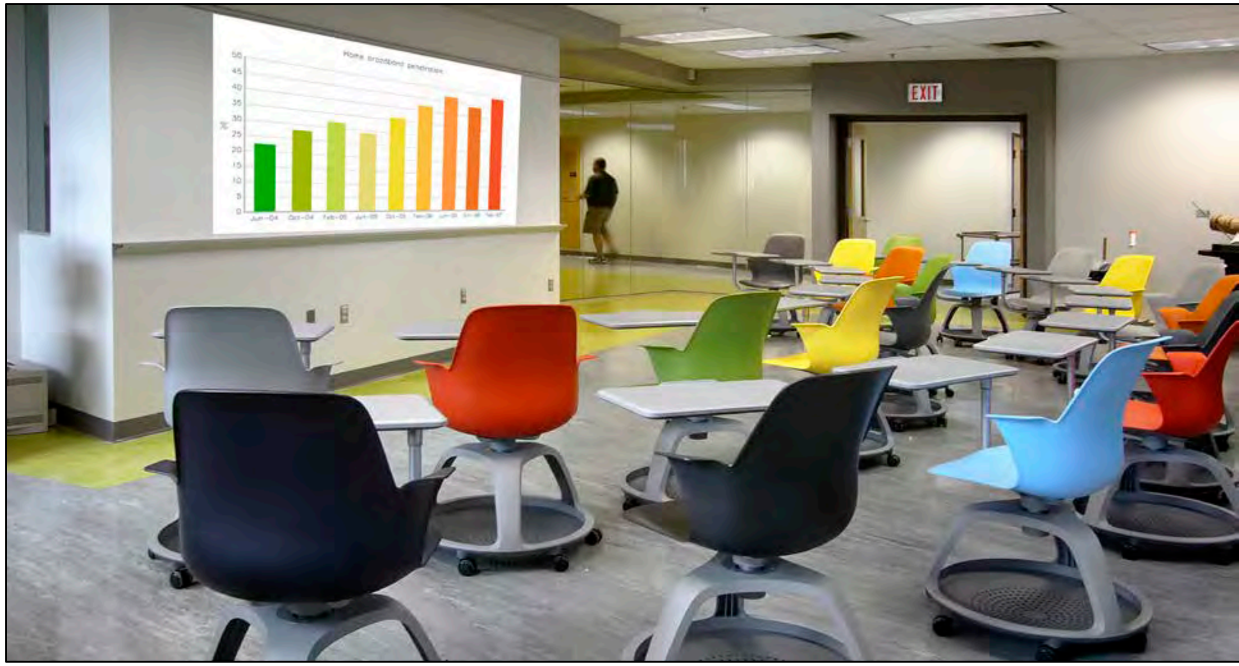
Top 10 skills and qualities for college graduates sought by employers

1. Leadership
2. Teamwork skills
3. Communication skills (written)
4. Problems-solving skills
5. Strong work ethic
6. Analytical skills
7. Technical skills
8. Communication skills (verbal)
9. Initiative
10. Computer skills

How much has
the way **students learn,**
the way **we teach,**
and the **spaces we use** for education,
changed over time

Replication has been the typical path forward....

Facilities and design solutions are not keeping up.


EXIT



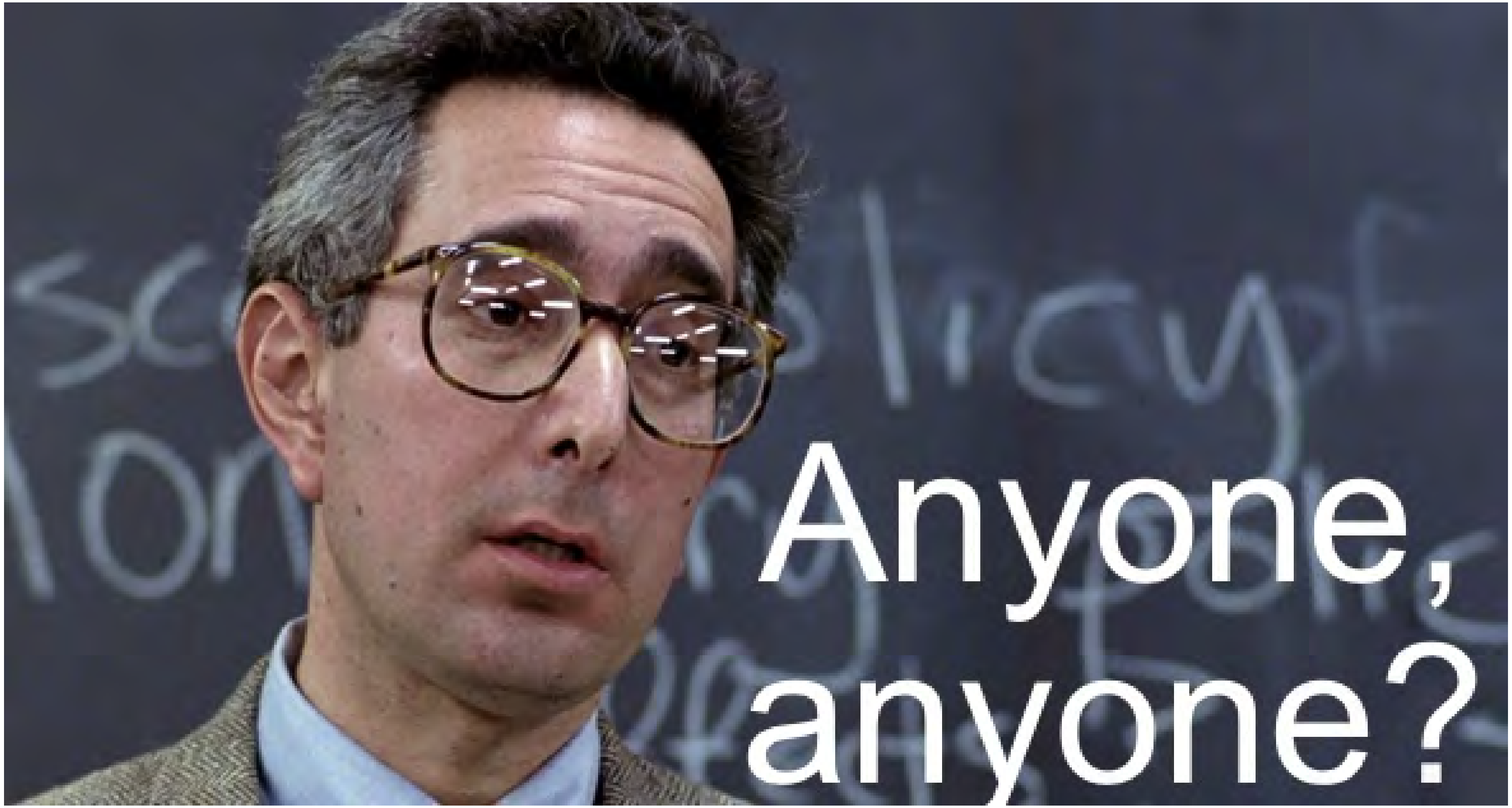


"Higher education is a thousand years of tradition wrapped in a hundred years of bureaucracy."
Moe, 1994


Sensory Systems
Leaving early
Twitter
email
FB check
Sensory Systems
Sensory Systems
Paying attention

Twitter
email
FB check
email
Not paying attention

What are we thinking?!

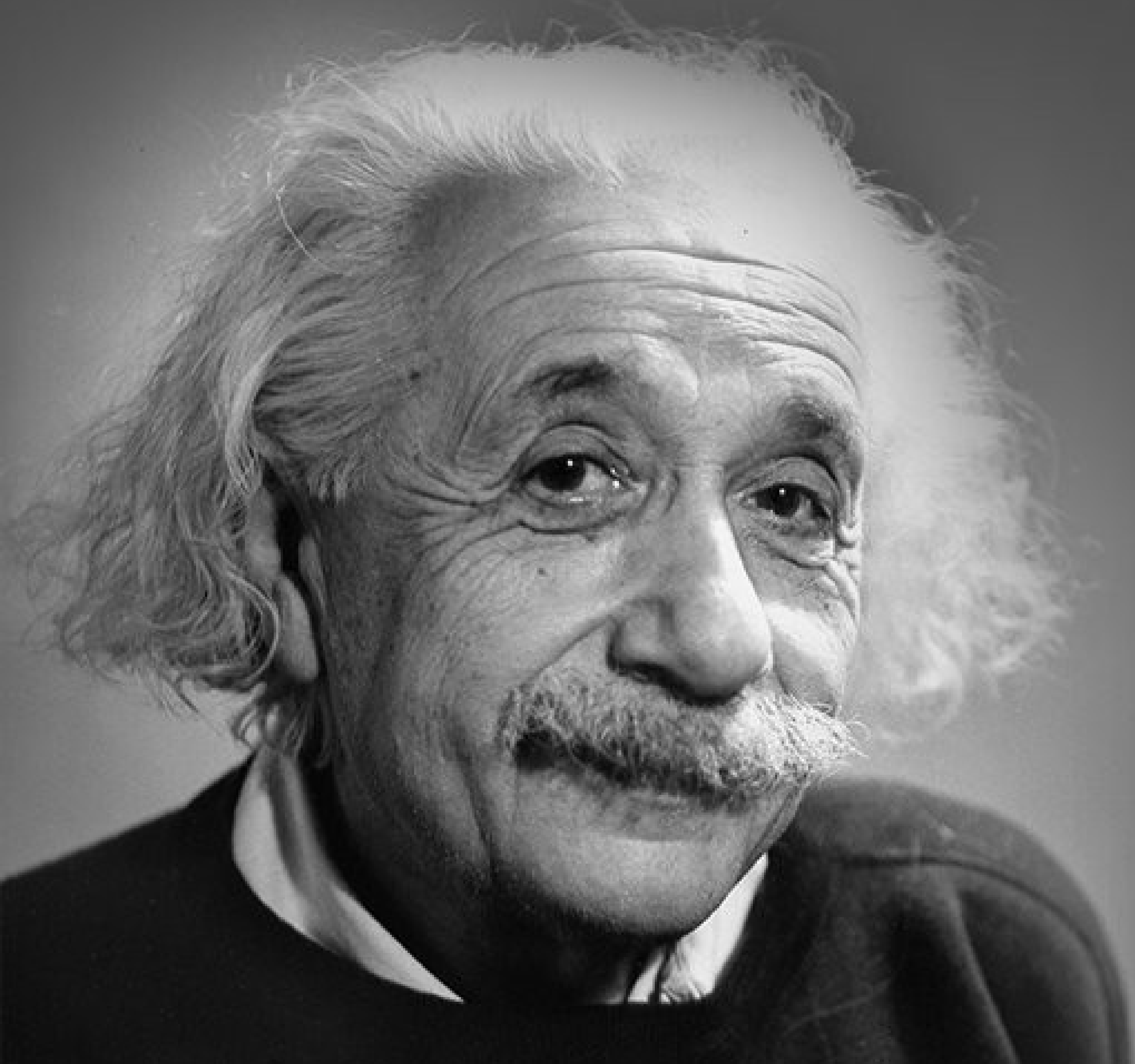


So, what should we be thinking about?

- All spaces are **academic opportunities**
- Learning spaces are also **social meeting places**
- **Flexible, blended** learning environments
- **Students as designers** of their environments

So, what should we be thinking about?

- Studio-based **team learning**
- Ready **access to resources**
- Spaces for **reflection and creativity**
- Design based on **pedagogy**
- Creative **classroom management** techniques
- **Undergraduate research** opportunities



We cannot solve our problems with the same thinking we used when we created them.

—Albert Einstein

2.

Planning and Programming process

What is a program?

Our take:
The most important stage in a project

Planning a project without a program is like planning a trip where you know the beginning and the end, but have no idea what happens along the way.

Living roadmap to a successful project

- Defines the **problem** & provides the framework to **solve** it
- Clearly expresses the **needs**
- Establishes the **dreams**, **goals** and **objectives**
- Identifies the **processes**
- Defines the **spaces**
- Establishes/validates the project **budget**
- Sets the project **schedule**
- Is completed in a timely manner

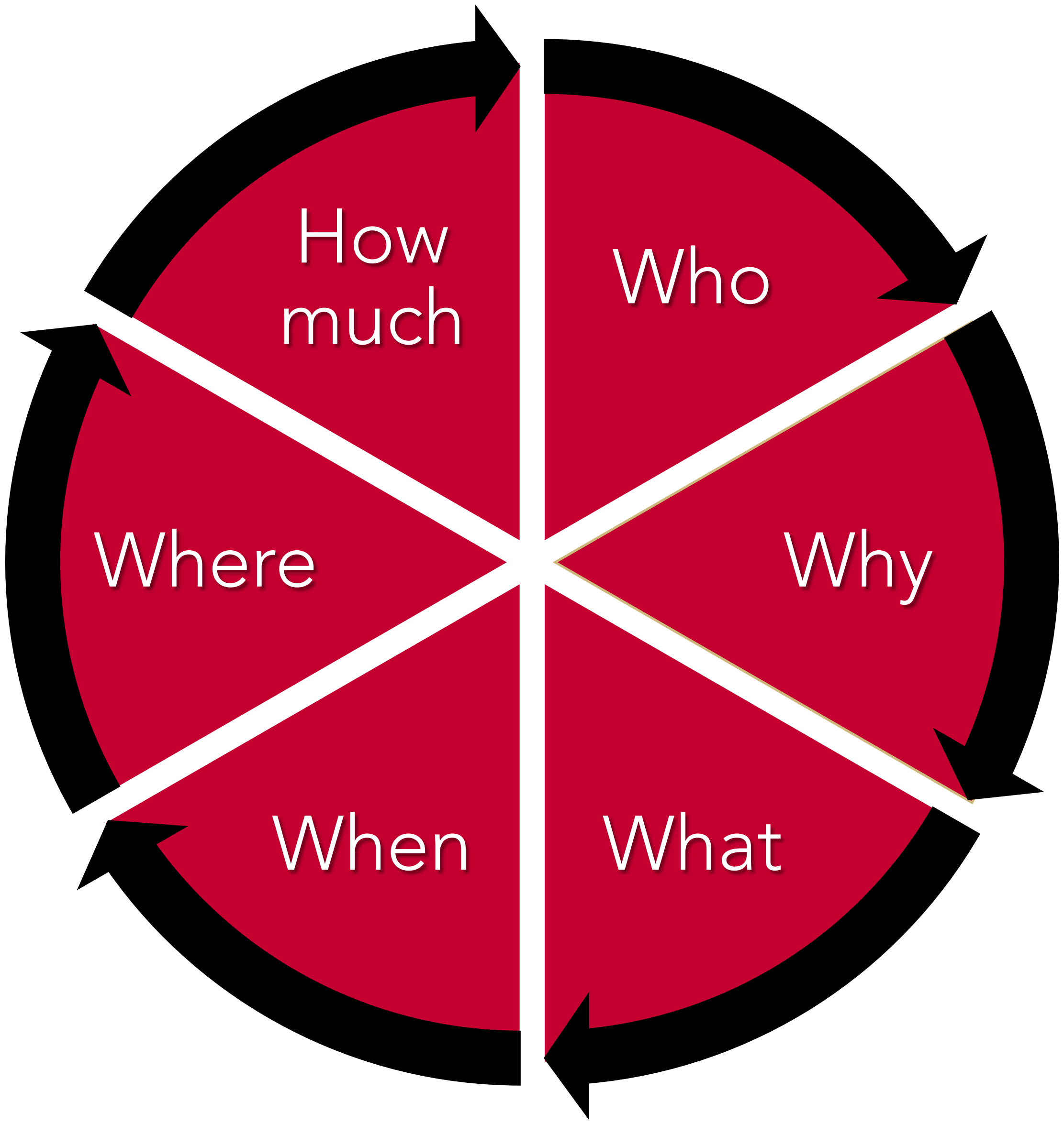
Based on simple philosophies:

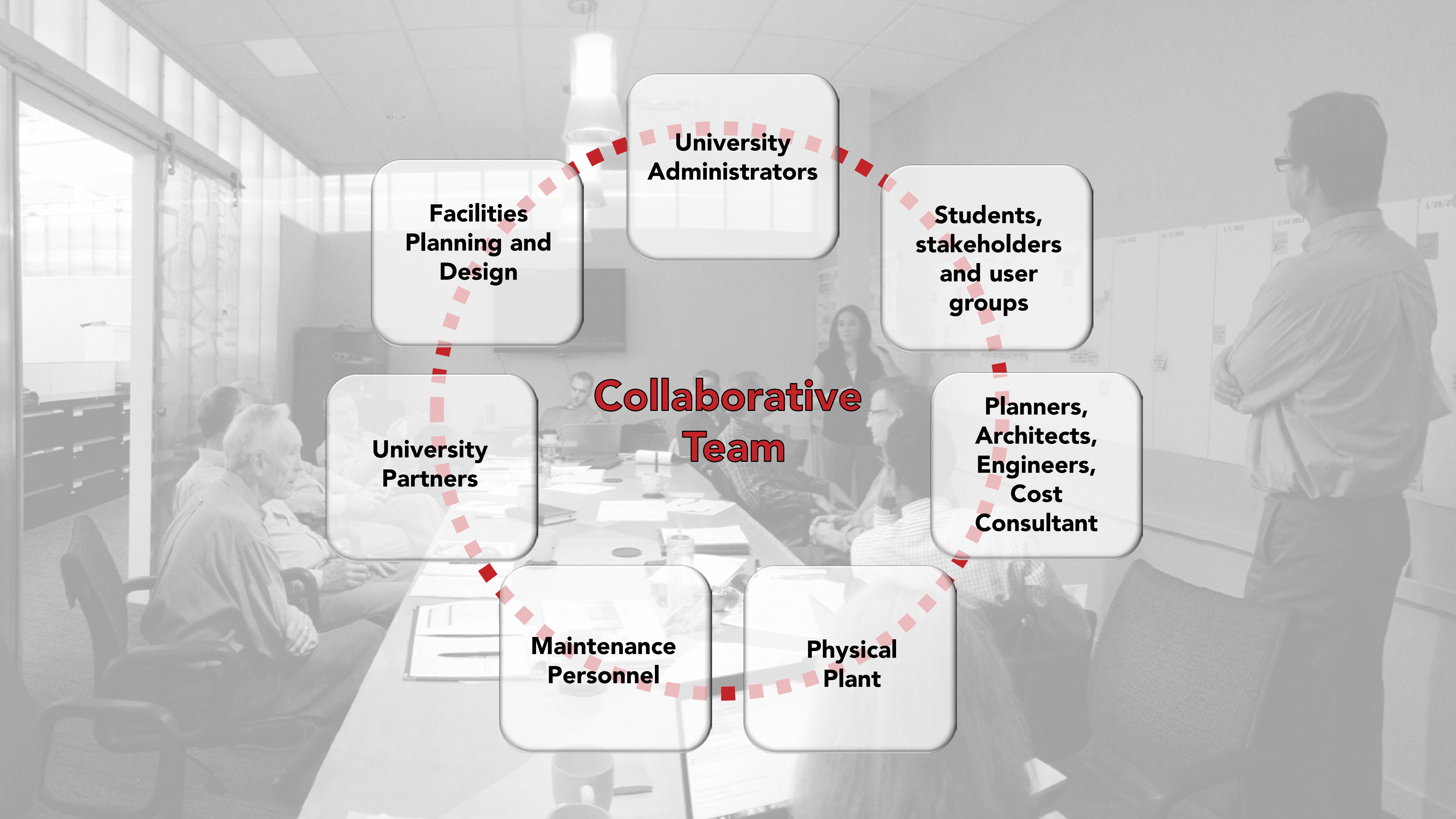
No single use can be planned in isolation

No two projects are the same

Programmers are facilitators, not dictators

Program elements





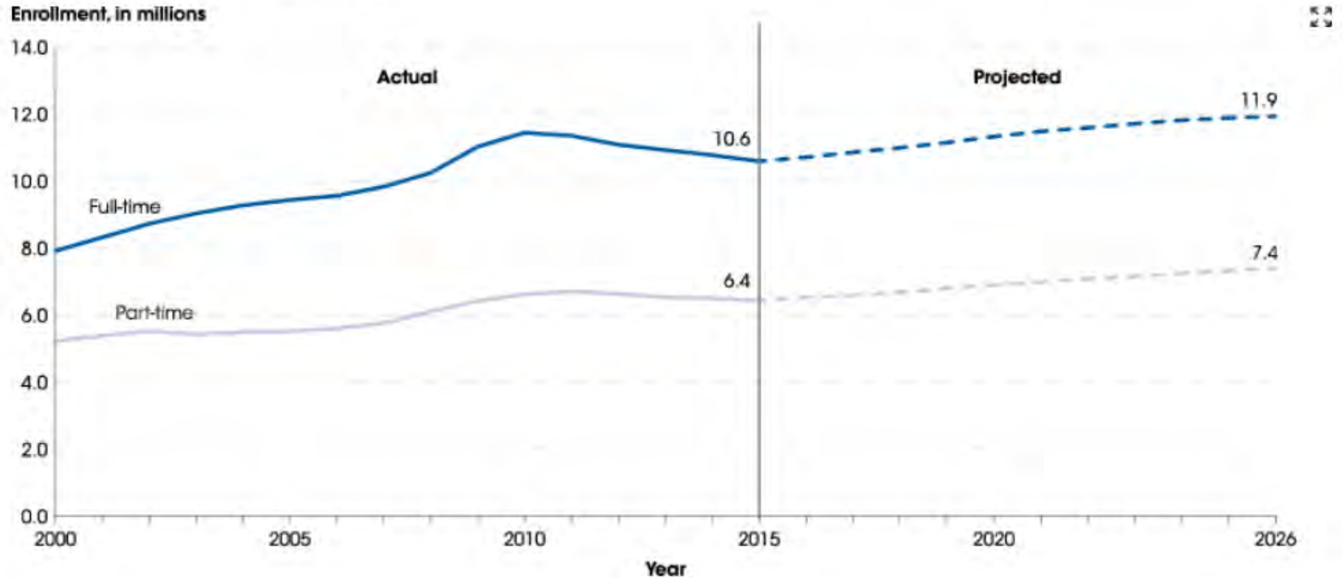
University Administrators
Students, stakeholders and user groups
Planners, Architects, Engineers, Cost Consultant
Physical Plant
Maintenance Personnel
University Partners
Facilities Planning and Design
Collaborative Team

- **Work collaboratively on site** so that all team members are accessible and connected
- **Engage all team members** in discussions about project goals, objectives and constraints
- **Listen intently** and collaborate on all programming elements
- **Learn** about programs and people
- **Share perspective** about past experiences and current industry trends
- **Respond** with a comprehensive programming and project definition document

Define needs based on:

- Existing deficiencies
- Change in programs
- New programs
- Growth
- Accreditation
- Institutional mandates
- Changes to mission, vision and goals
- Strategic plan modifications
- Future

Figure 3. Actual and projected undergraduate enrollment in degree-granting postsecondary institutions, by attendance status: Fall 2000–2026



Establish dreams, goals and objectives

- **ORGANIZATIONAL:** owner's big picture
- **FORM & IMAGE:** aesthetics
- **FUNCTIONAL:** activities, occupancy & interaction
- **ECONOMIC:** budget + operating and maintenance costs
- **TIME:** short-term & long-term plans

ORGANIZATIONAL: Owner's big picture

- Dream BIG
- Don't be constrained by what you know now and what you have now
- Challenge all preconceptions

FORM AND IMAGE: Aesthetics

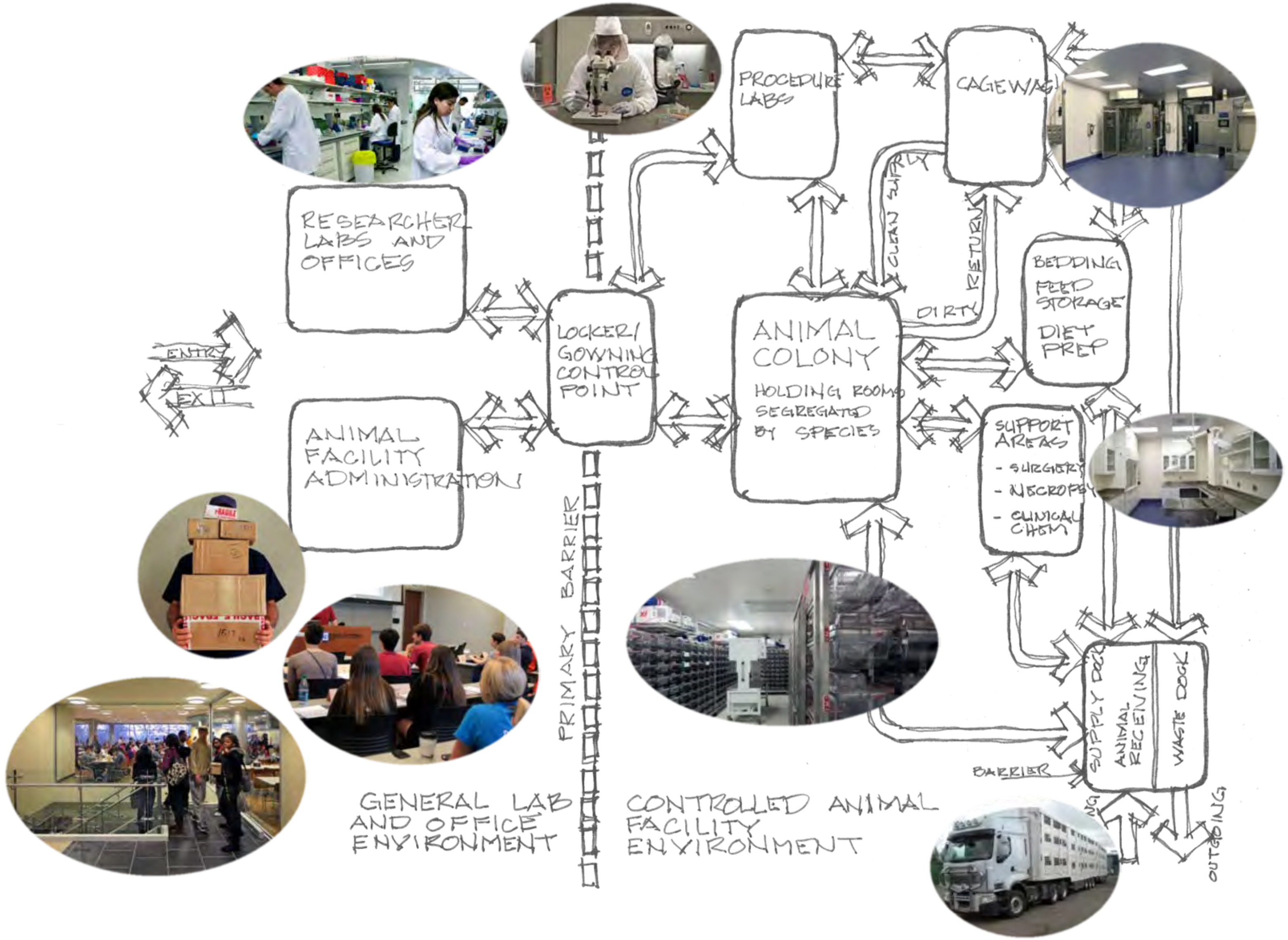
- Master plan compliance
- Design standards
- Connection to adjacent buildings
- Campus gateways
- Science on display

BOARD OF REGENTS OF THE UNIVERSITY SYSTEM OF GEORGIA

UNIVERSITY SYSTEM OF GEORGIA

FUNCTIONAL: Activities, occupancy & Interaction

- People
- Equipment
- Supplies
- Activities
- Function



Define all assignable, useable spaces:

- Core facilities
- Offices
- Research labs
- Instructional labs
- Project spaces
- Classrooms
- Support spaces
- Student success spaces
- Collaborative spaces
- Other assignable spaces





Program Summary

SPACE TYPES	PHASE 1			PHASE 2			PHASE 3			NOTES
	Area (NSF)	Qty	Total Area (NSF)	Area (NSF)	Qty	Total Area (NSF)	Area (NSF)	Qty	Total Area (NSF)	
Building Common			**800**			**0**			**1,200**	
Lobby	500	1	500							
Conference Room	300	1	300							
Computer Classroom							1,200	1	1,200	
Office			**4,000**			**0**			**800**	
Faculty	100	6	600							
Huddle Room	100	1	100							
Graduate Student	50	62	3,100							
Technician	200	1	200							
CTTP Staff							100	8	800	
Structural Labs (Steel and Concrete)			**25,200**			**0**			**0**	
Strong Floor (High Bay)	5,000	1	5,000							50'x100'
Staging Area (High Bay)	2,500	1	2,500							
Storage Area (High Bay)	3,500	1	3,500							
Service Chase below Strong Floor (High Bay)	6,500	1	6,500							
Drive Lane (High Bay)	1,000	1	1,000							
Material Testing	1,500	1	1,500							
Concrete Mixing and Testing	2,400	1	2,400							
Metallurgy	600	1	600							
Fabrication Shop	1,200	1	1,200							
Wind Engineering (High Bay)	1,000	1	1,000							small vortex chamber
Geotechnical Labs			**2,500**			**0**			**0**	
Sample Prep	500	1	500							
Sample Test	500	1	500							
Soil Box Room	500	1	500							
Direct Shear	500	1	500							
Seismic Lab, common room	300	1	300							
Seismic Lab, small	100	2	200							
Asphalt Labs			**0**			**4,800**			**0**	
DSR				400	1	400				
Specific Gravity				500	1	500				
Mixing/Compaction/Testing				2,200	1	2,200				
Sample Prep				500	1	500				
Aggregate Lab				1,200	1	1,200				
CTTP Labs			**0**			**0**			**6,400**	
Training Classroom (flexible classroom)							1,200	1	1,200	50 people
Training Conference Room							200	1	200	10 people
Training Storage							200	1	200	
Asphalt							1,600	1	1,600	open labs
Concrete							1,600	1	1,600	open labs
Support Lab							400	1	400	shared support, storage and shakers
Testing							1,200	1	1,200	(12) 8'x8' setup stations
Student Projects			**2,000**			**0**			**0**	
Student Fabrication (High Bay)	2,000	1	2,000							open and flexible
			34,500			**4,800**			**8,400**	

PROGRAM MODEL - ANALYSIS

	ANSF	Efficiency	GSF	Grossing
Administrative	10,141	70.0%	14,487	4,346
Research	12,418	55.0%	22,578	10,160
Instructional Laboratories	35,753	55.0%	65,005	29,252
Collaborative Learning Spaces	6,893	65.0%	10,605	3,712
Senior Design - Project/Maker Spaces	16,920	65.0%	26,031	9,111
Building Services	4,023	70.0%	5,747	1,724
Grossing - Typical (includes building support spaces)				58,305
Total ANSF	86,148	59.6%	GSF	144,454

Efficiency

Type of facility	Low end efficiency	High end efficiency	Average efficiency
Instructional	62%	68%	65%
Research	56%	64%	60%
Animal Research	30%	60%	45%
Bio-Containment	30%	50%	40%



Example STEM Research Facility	
Programmed lab and lab support spaces	38,500 NSF
Programmed office/conference/support spaces	16,500 NSF
Total programmed space:	55,000 NSF
Estimated efficiency at program stage:	**64%**
Total GSF at program stage	85,938 GSF
Estimated construction cost of facility ($400/GSF):	$34,375,200
Estimated total project cost ($520/GSF):	$44,687,760
Actual Efficiency:	**60%**
Actual GSF of Facility:	91,667 SF
Estimated Construction Cost of Facility ($400/GSF):	$36,666,800
Difference Between Program and Actual:	$2,291,600
Actual Total Project Cost ($520/GSF):	$47,666,840
Difference Between Program and Actual:	$2,979,080*

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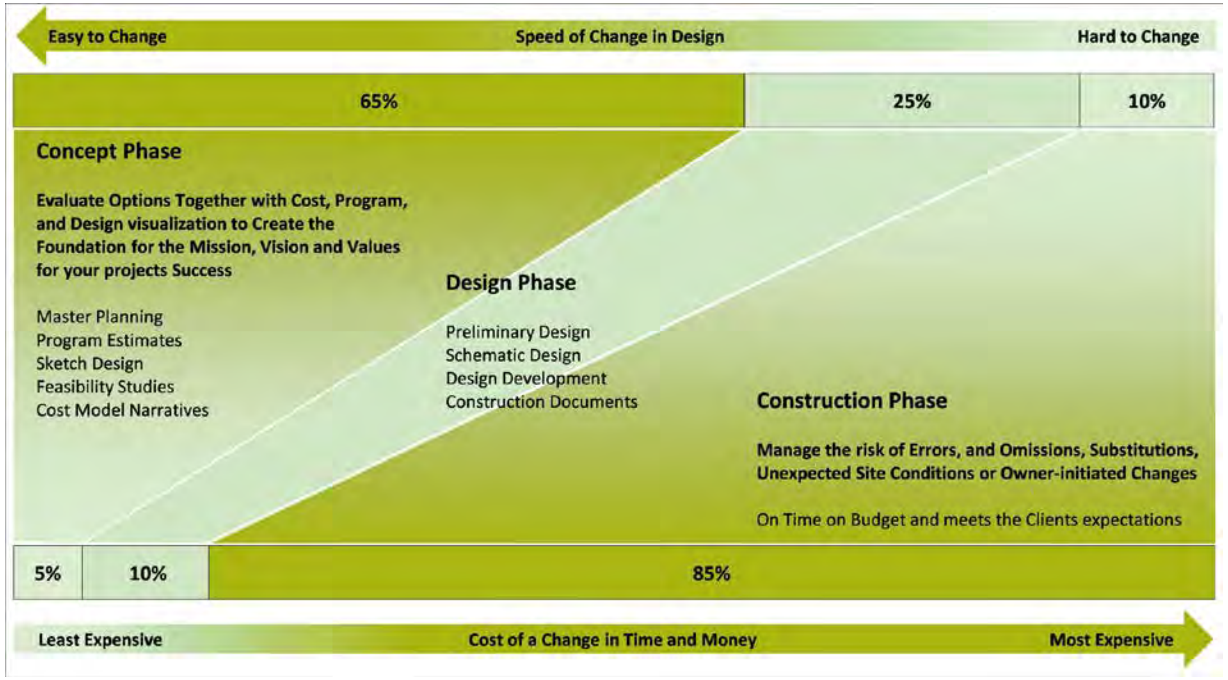
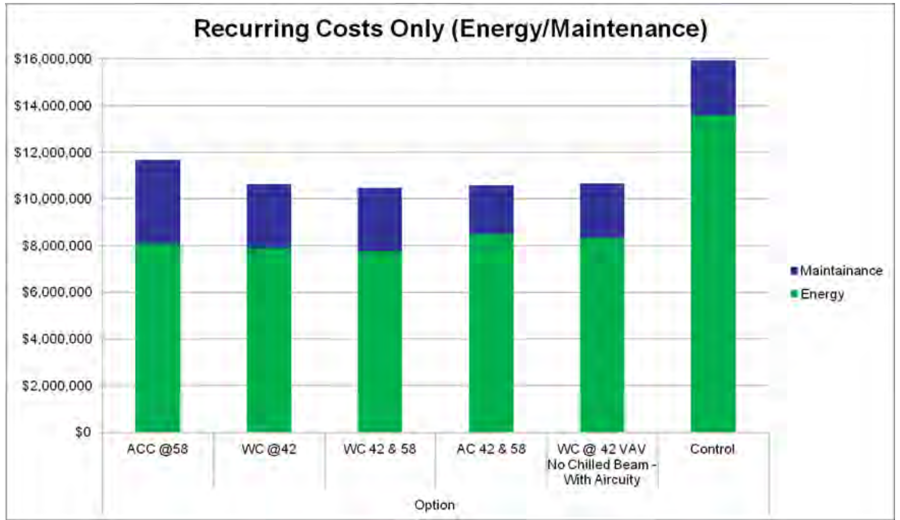
To maintain the project budget established at the program stage, a **3,437 NSF reduction of programmed space** is required.

ECONOMIC: budget + operating and maintenance costs

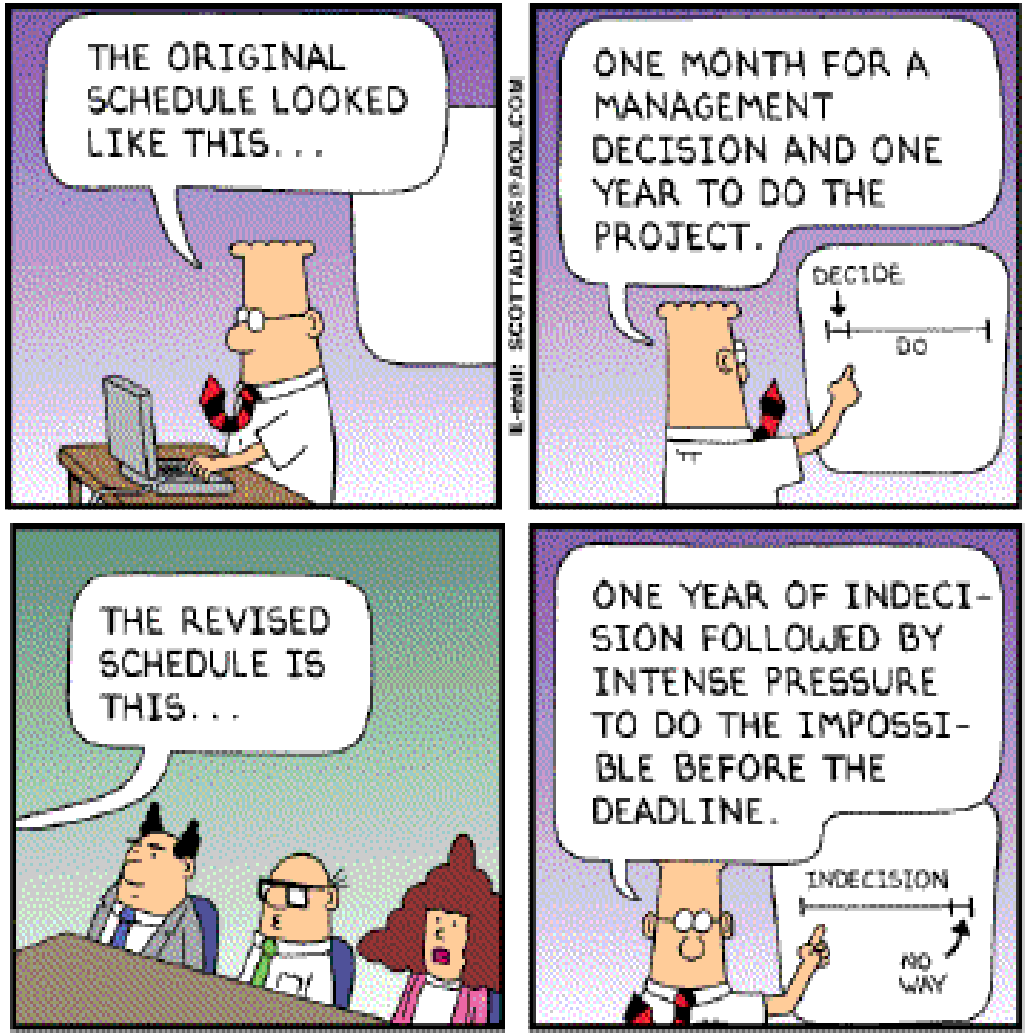
- Establish/confirm budget
- Identify philosophies and constraints: initial cost vs. long range costs
- Balance budget and schedule
- Determine sustainability goals and requirements
- Life cycle costing
- Deferred maintenance





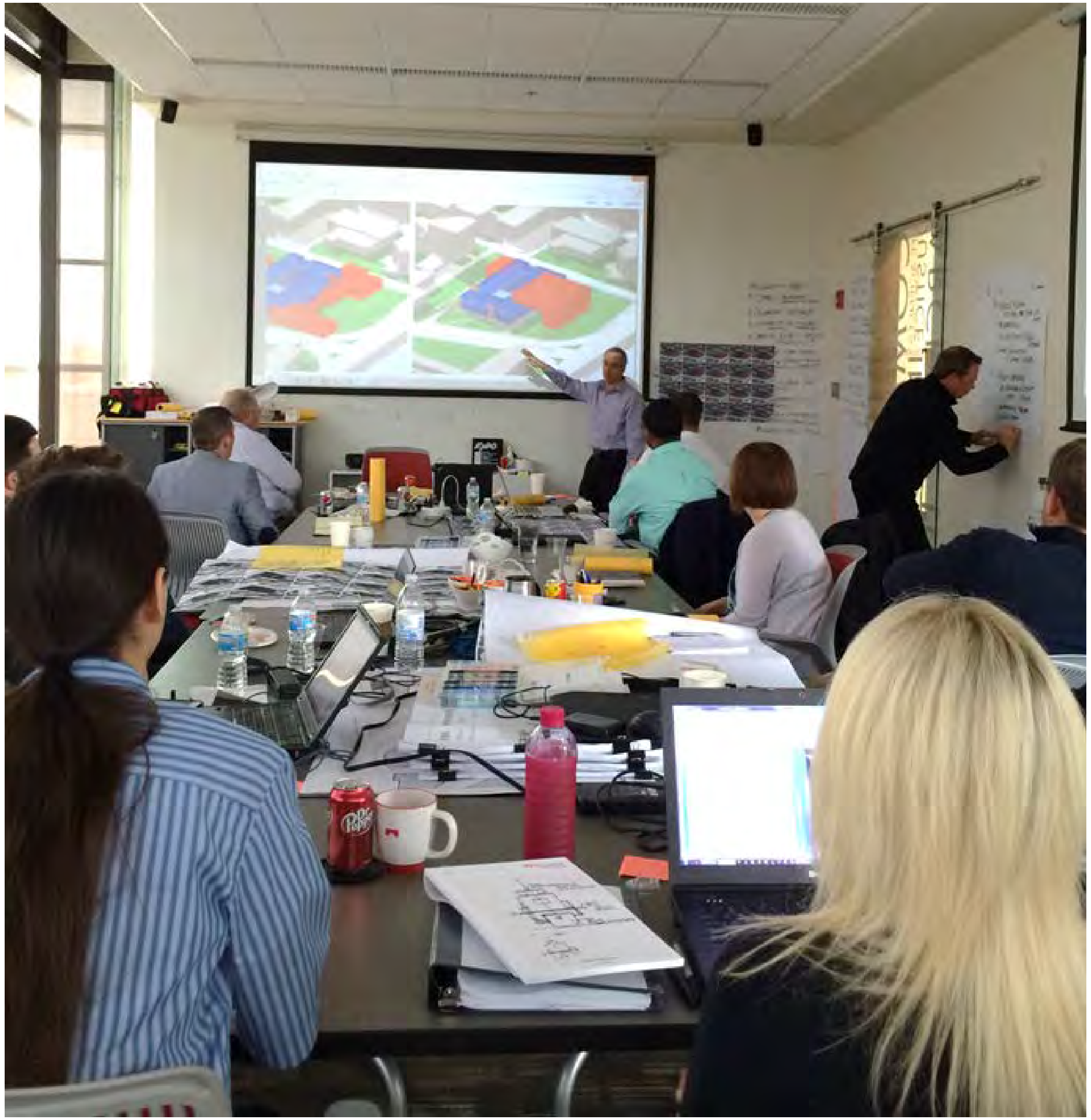
TIME: short-term & long-term plans

- Complete program in a timely manner
- Phasing
- Revenue resources
- Anticipated long term changes
- Current and future market conditions
- Project delivery method
- Commissioning
- Move in



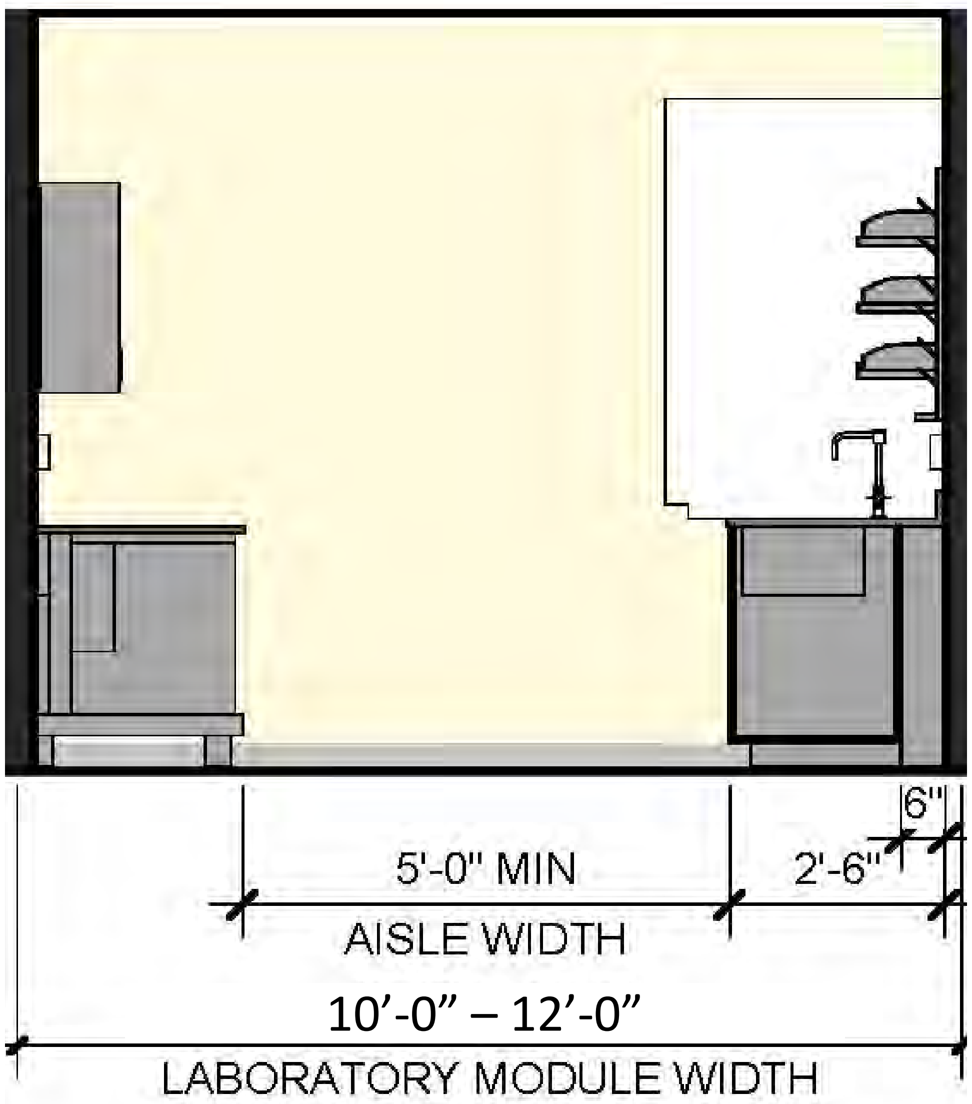
Tools we use

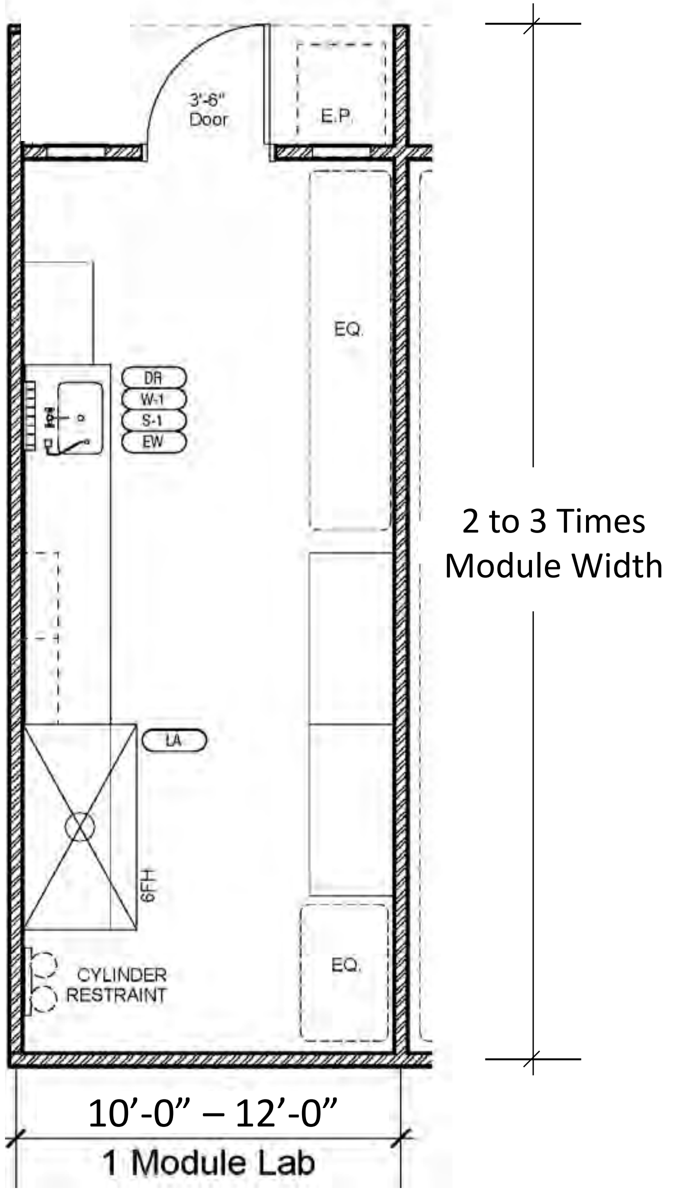
- Transparent communication
- Modular planning
- Information gathering
- Perspective



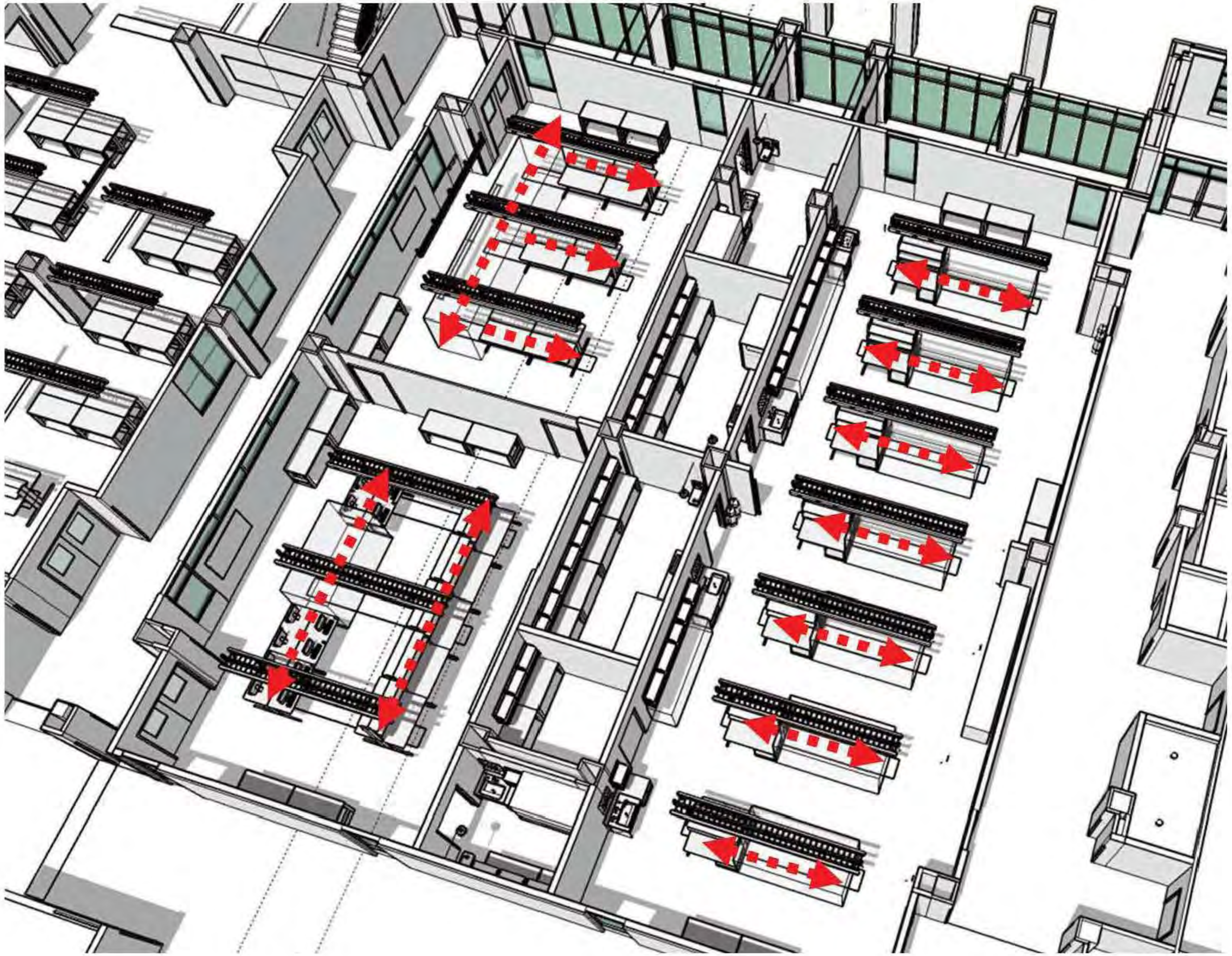
MODULAR PLANNING

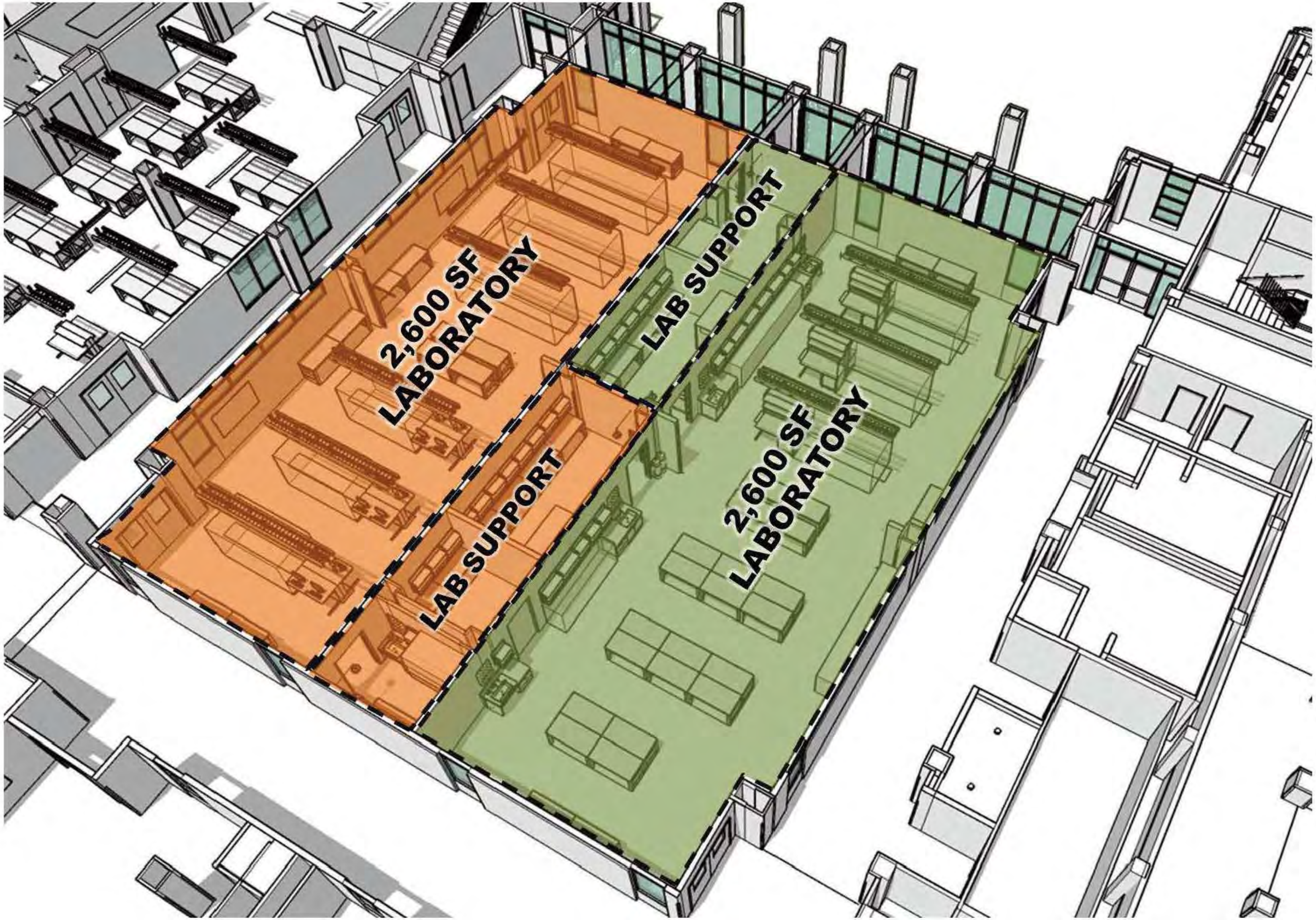
- Organizational tool to define individual spaces & layout
- Not the final floor plan
- Improves efficiencies of building systems and structure


6"
5'-0" MIN
2'-6"
AISLE WIDTH
10'-0" – 12'-0"
LABORATORY MODULE WIDTH

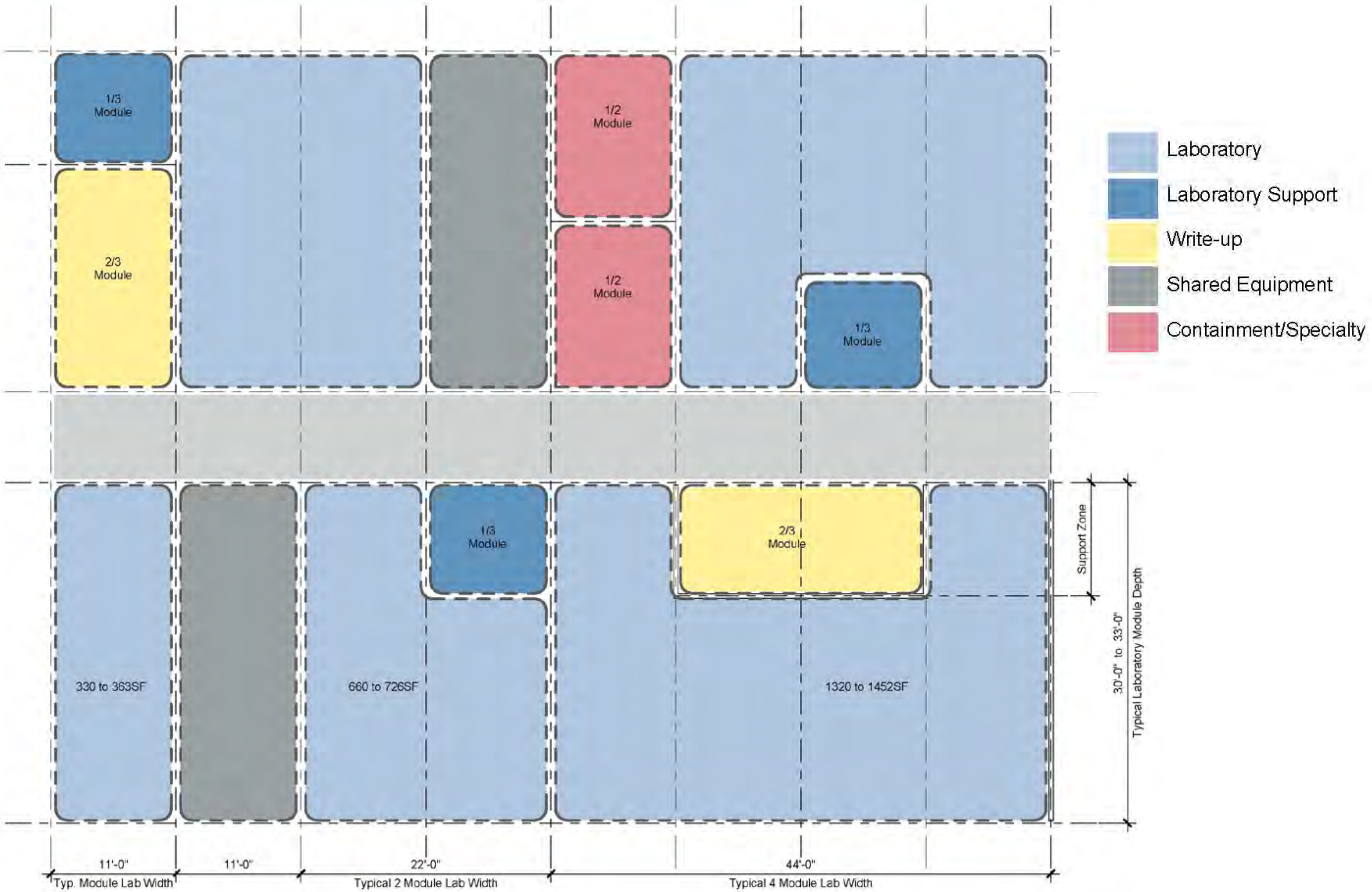

3'-6"
Door
E.P.
EQ.
DR
W-1
S-1
EW
LA
6FH
CYLINDER
RESTRAINT
EQ.
2 to 3 Times
Module Width
10'-0" – 12'-0"
1 Module Lab

MULTI-DIRECTIONAL MODULES

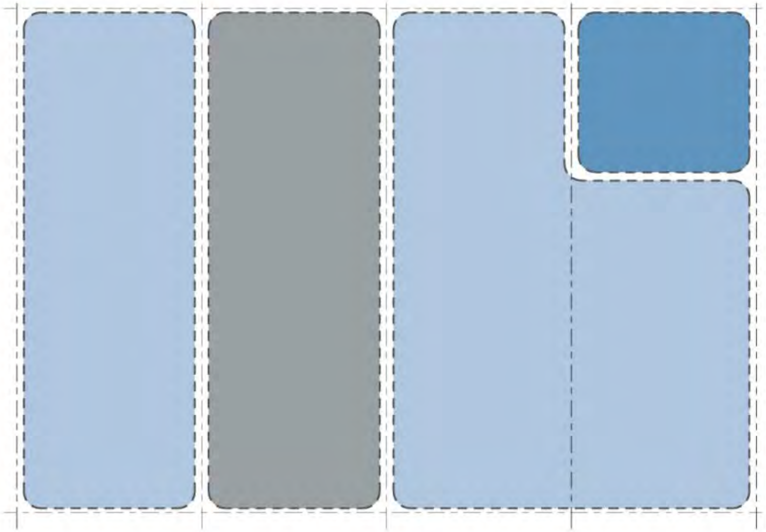


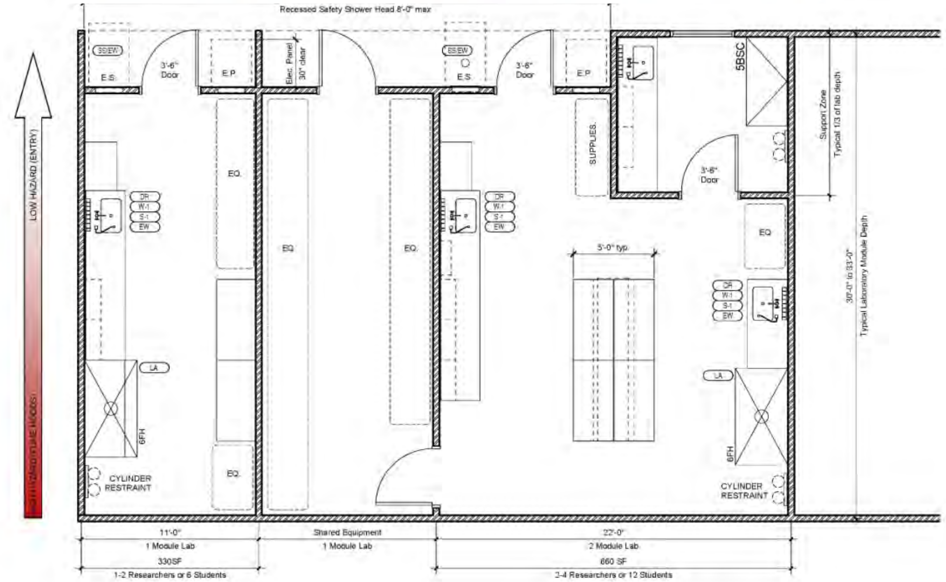

2,600 SF
LABORATORY
LAB SUPPORT
LAB SUPPORT
2,600 SF
LABORATORY


1,300 SF LABORATORY
1,300 SF LABORATORY
1,300 SF LABORATORY
1,300 SF LABORATORY

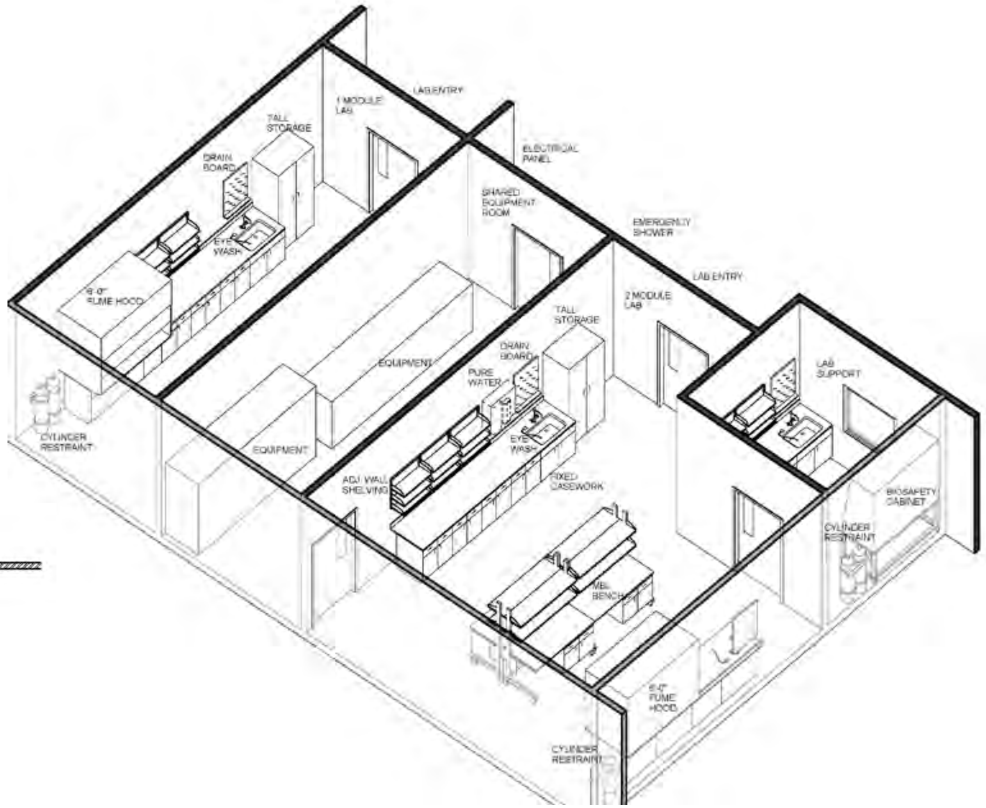


1/3 Module
2/3 Module
1/2 Module
1/2 Module
1/3 Module
Laboratory
Laboratory Support
Write-up
Shared Equipment
Containment/Specialty
1/3 Module
2/3 Module
Support Zone
330 to 363SF
660 to 726SF
1320 to 1452SF
30'-0" to 33'-0"
Typical Laboratory Module Depth
11'-0"
11'-0"
22'-0"
44'-0"
Typ. Module Lab Width
Typical 2 Module Lab Width
Typical 4 Module Lab Width





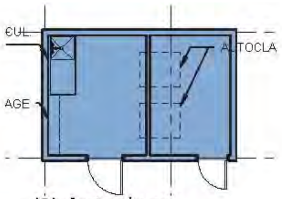
Recessed Safety Shower Head 8'-0" max
LOW HAZARD (ENTRY)
SS/EW
E.S.
3'-6" Door
E.P.
Elec. Panel 30" clear
SS/EW
E.S.
3'-6" Door
E.P.
5BSC
Support Zone
Typical 1/3 of lab depth
SUPPLIES
3'-6" Door
EQ.
DR
W-1
S-1
EW
EQ.
EQ.
EQ.
DR
W-1
S-1
EW
5'-0" typ.
EQ
DR
W-1
S-1
EW
30'-0" to 33'-0"
Typical Laboratory Module Depth
LA
6FH
EQ.
CYLINDER RESTRAINT
LA
6FH
CYLINDER RESTRAINT
11'-0"
1 Module Lab
330SF
1-2 Researchers or 6 Students
Shared Equipment
1 Module Lab
22'-0"
2 Module Lab
660 SF
2-4 Researchers or 12 Students



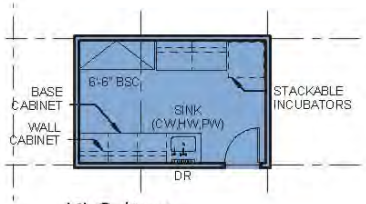
LAB ENTRY
1 MODULE LAB
TALL STORAGE
DRAIN BOARD
ELECTRICAL PANEL
SHARED EQUIPMENT ROOM
EYE WASH
6'-0" FUME HOOD
EMERGENCY SHOWER
LAB ENTRY
2 MODULE LAB
TALL STORAGE
DRAIN BOARD
EQUIPMENT
PURE WATER
LAB SUPPORT
CYLINDER RESTRAINT
EQUIPMENT
EYE WASH
ADJ. WALL SHELVING
FIXED CASEWORK
BIOSAFETY CABINET
CYLINDER RESTRAINT
MBL BENCH
6'-0" FUME HOOD
CYLINDER RESTRAINT

Research

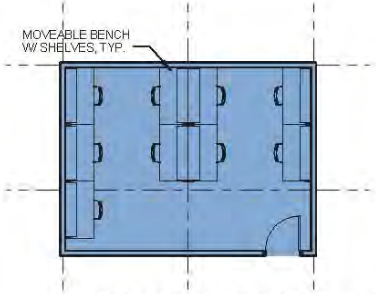
	Lab Mod NSF	Lab Mod Qty	ANSF per Room	Room / Unit Qty	Total ANSF	Subtotal
IMDTD						**19,964**
Wet Research Lab	363	1.667	605	20	12,100	
Synthetic Chemistry	363	1.667	605	4	2,420	
Culture	363	0.500	182	6	1,089	
Microscopy	363	0.333	121	6	725	
Equipment	363	0.500	182	6	1,089	
Analytical Instrumentation	363	0.333	121	3	363	
Histology	363	0.667	242	1	242	
Storage	363	0.333	121	4	484	
Autoclave	363	0.500	182	2	363	
Animal Procedure	363	0.333	121	3	363	
Analytical / Computational Dry Lab	363	1.000	363	2	726	



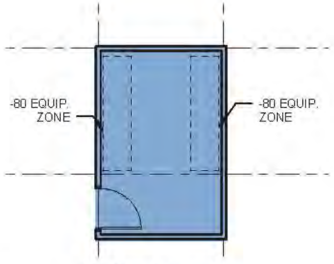
(2) Autoclave



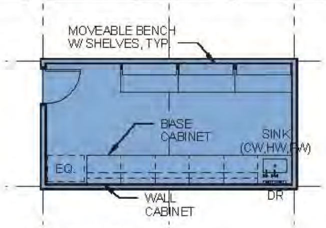
(6) Culture



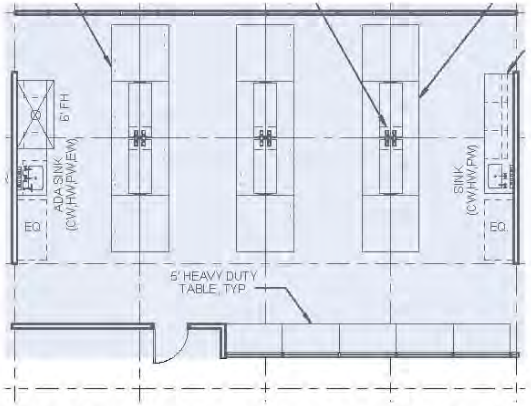
(2) Analytical / Computational Dry Lab



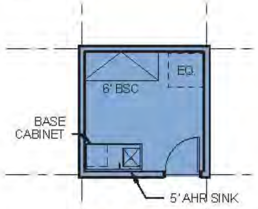
(6) Equipment



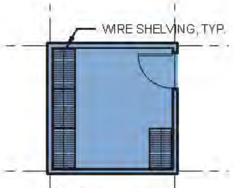
Histology



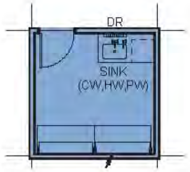
(20) Wet Research Lab - *diagram represents 2 units*



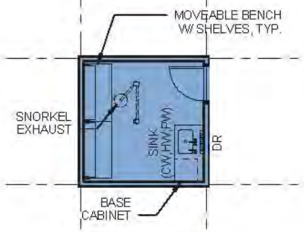
(3) Animal Procedure



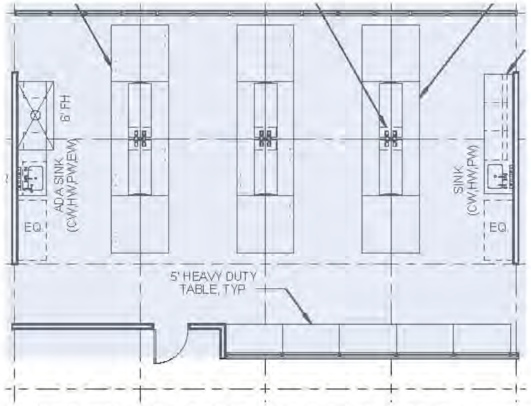
(4) Storage



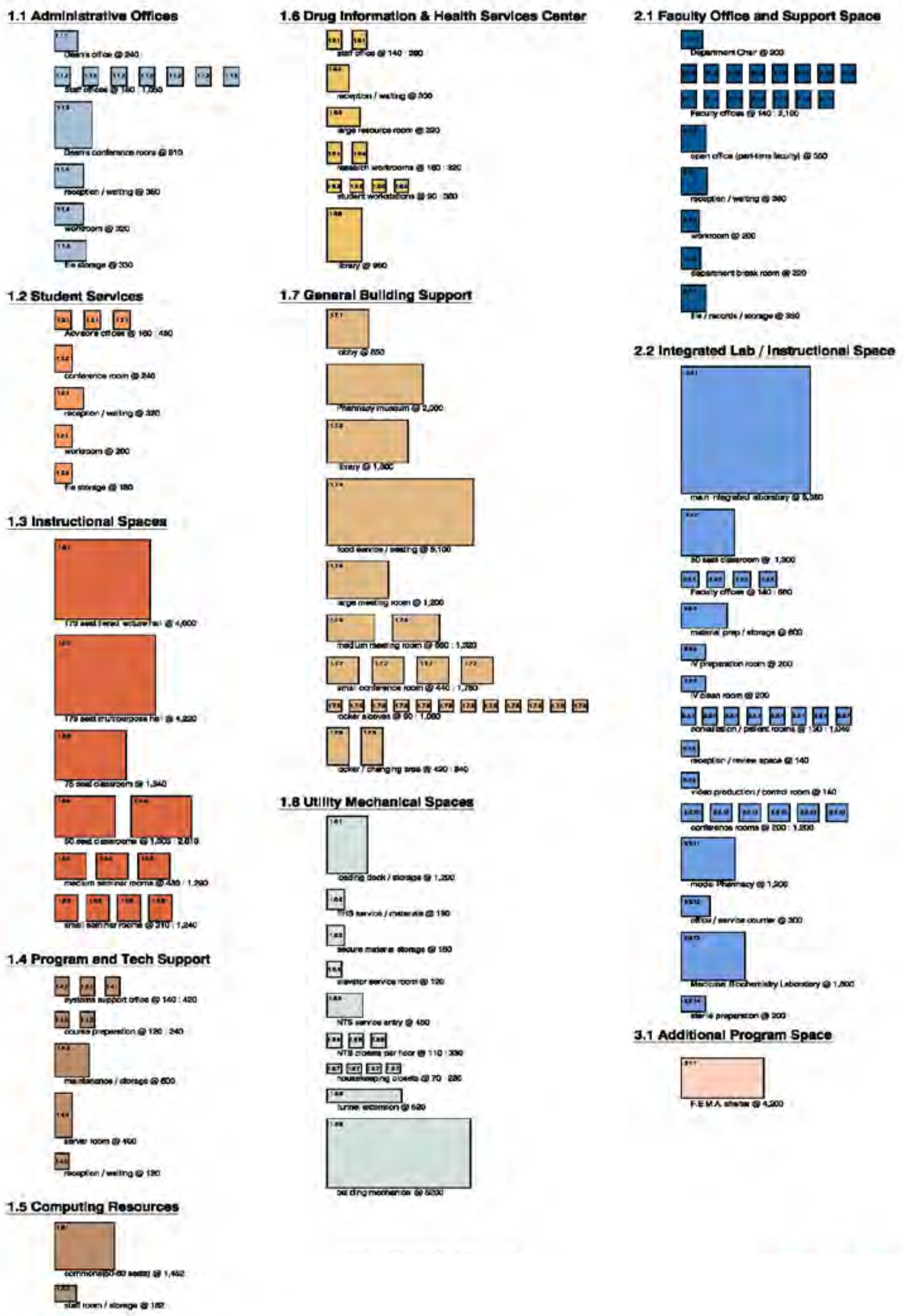
(6) Microscopy

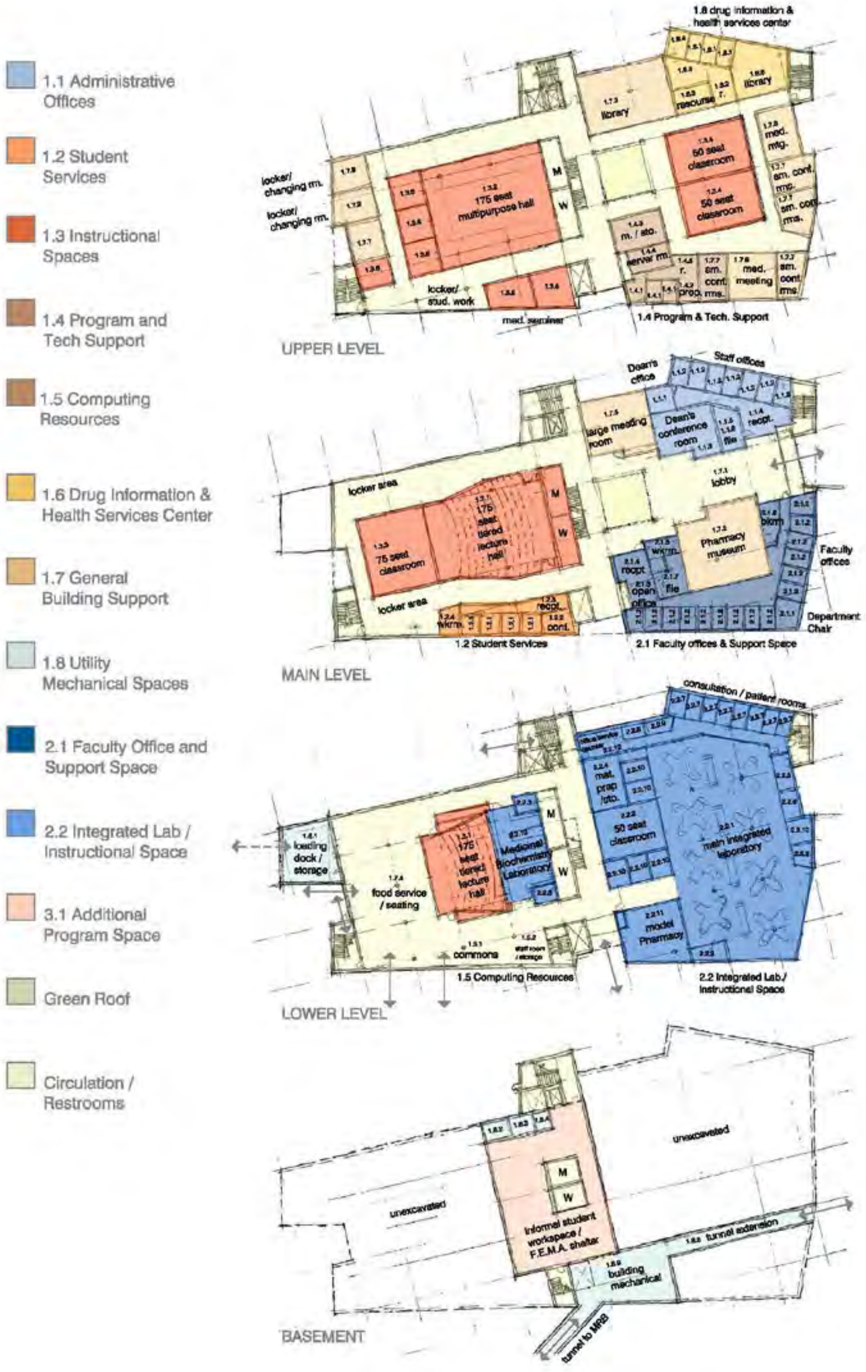


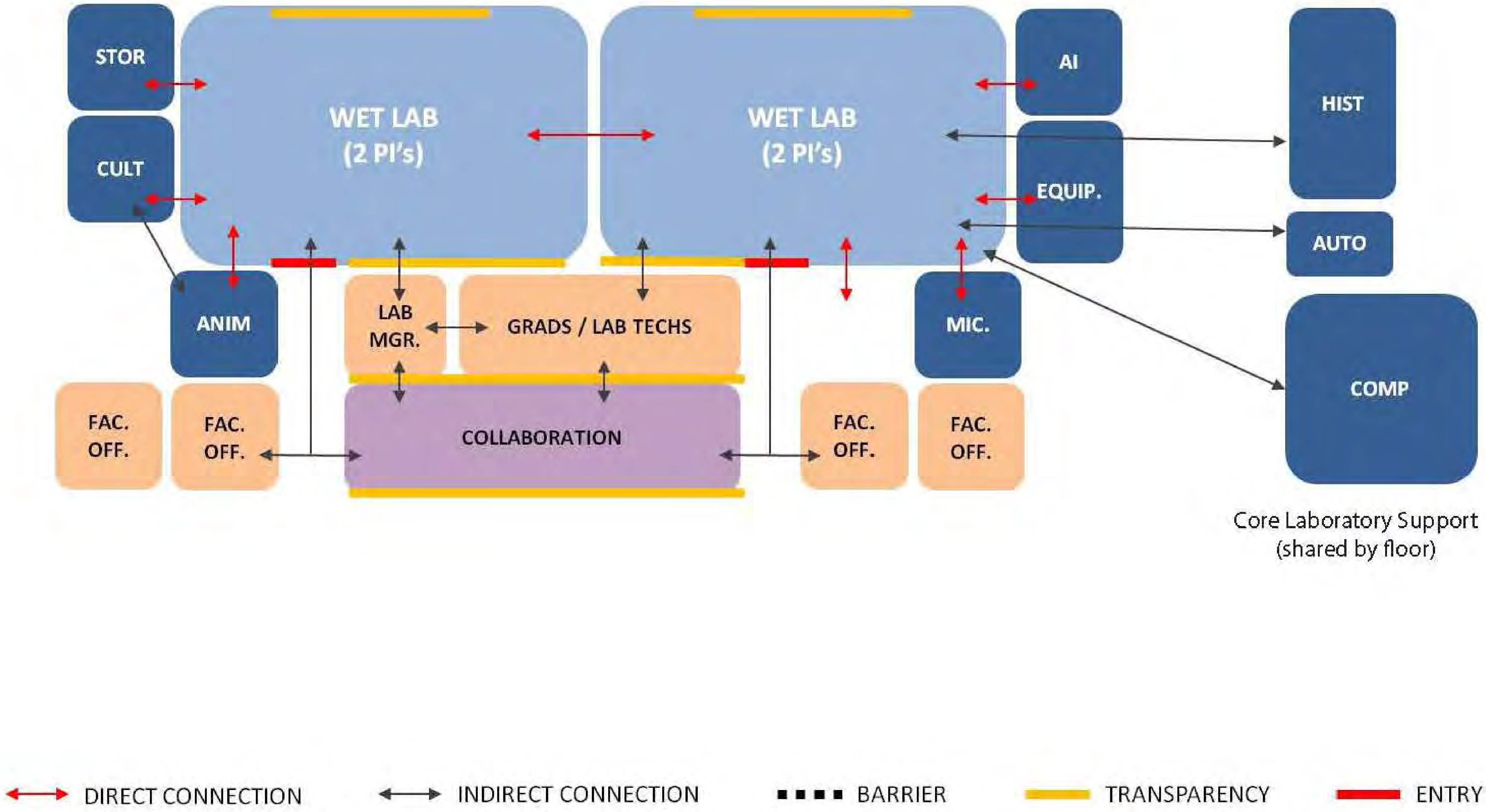
(3) Analytical Instrumentation



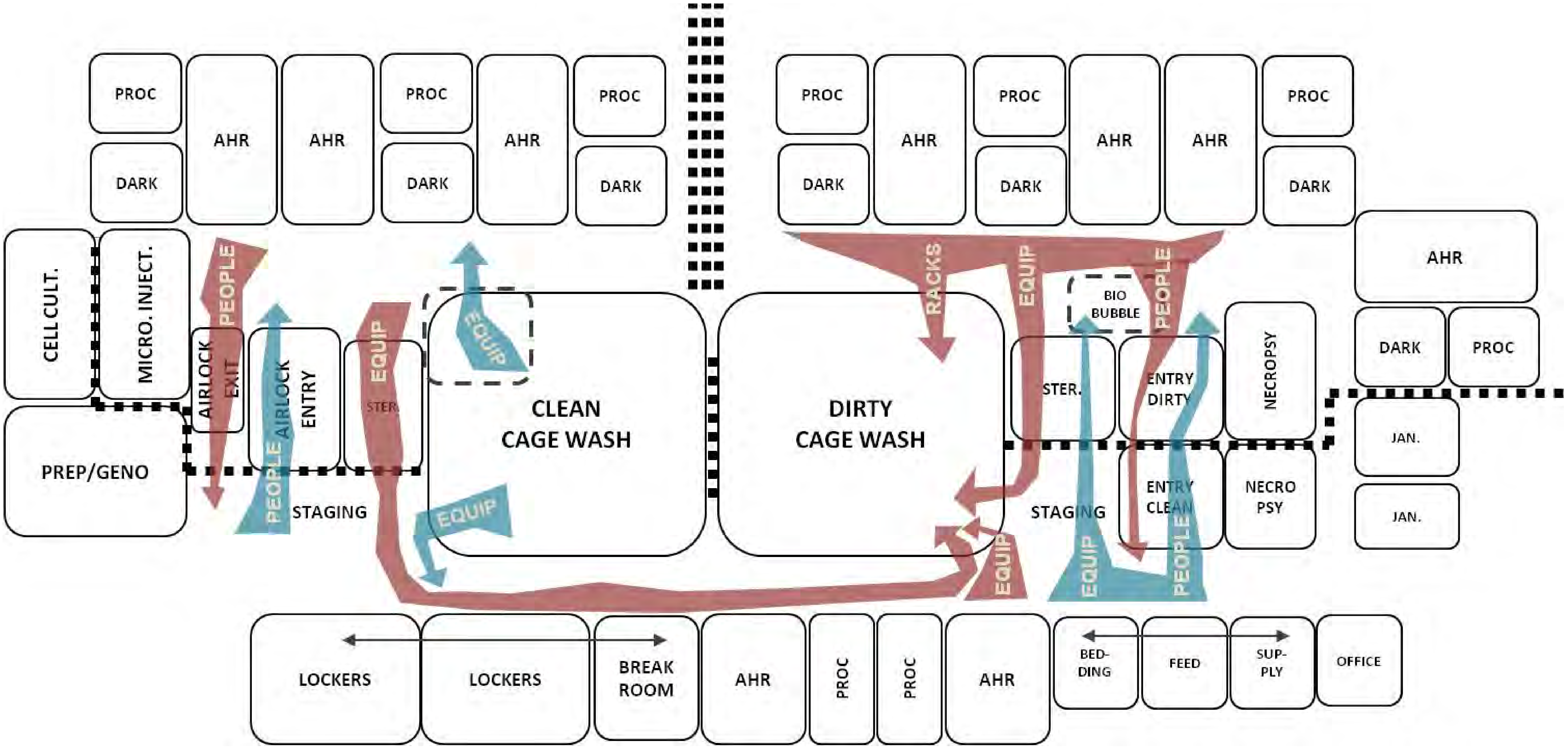
(4) Synthetic Chemistry - *diagram represents 2 units*

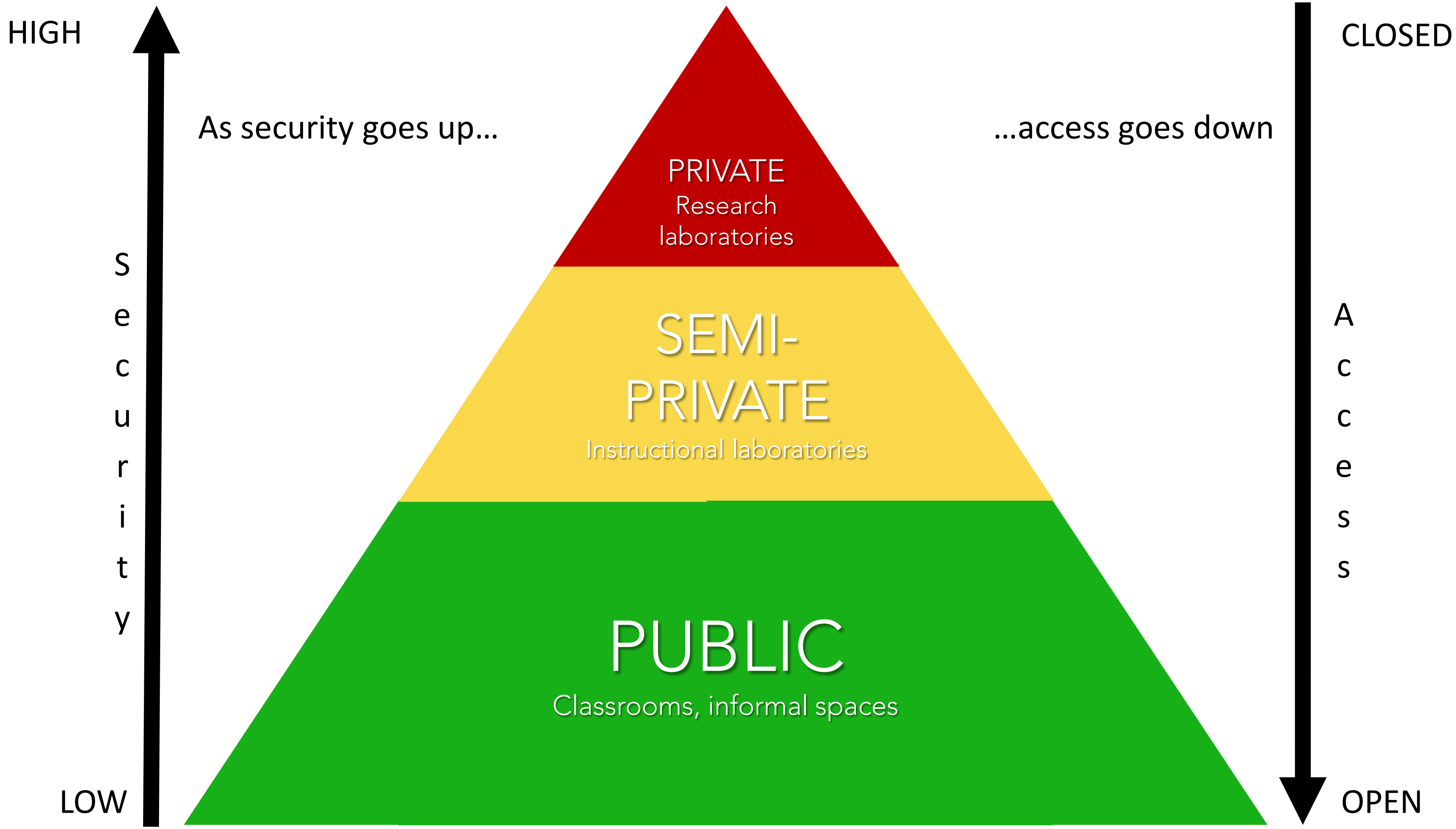

1.1 Administrative Offices
1.2 Student Services
1.3 Instructional Spaces
1.4 Program and Tech Support
1.5 Computing Resources
1.6 Drug Information & Health Services Center
1.7 General Building Support
1.8 Utility Mechanical Spaces
2.1 Faculty Office and Support Space
2.2 Integrated Lab / Instructional Space
3.1 Additional Program Space

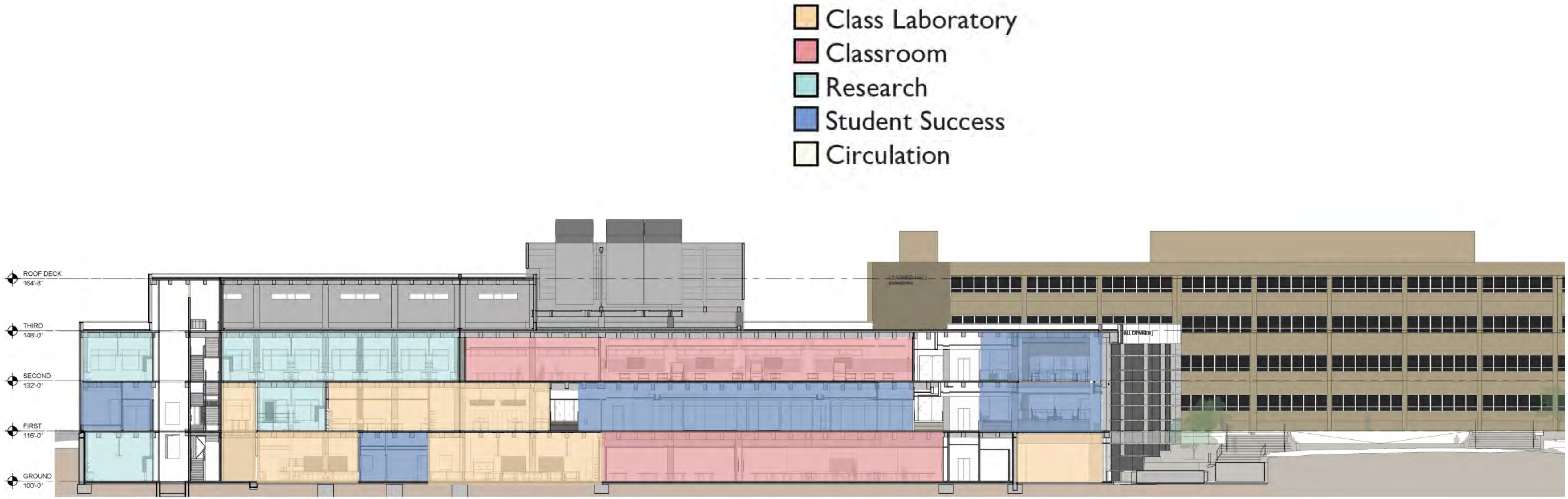

1.1 Administrative Offices
1.2 Student Services
1.3 Instructional Spaces
1.4 Program and Tech Support
1.5 Computing Resources
1.6 Drug Information & Health Services Center
1.7 General Building Support
1.8 Utility Mechanical Spaces
2.1 Faculty Office and Support Space
2.2 Integrated Lab / Instructional Space
3.1 Additional Program Space
Green Roof
Circulation / Restrooms
UPPER LEVEL
MAIN LEVEL
LOWER LEVEL
BASEMENT


STOR
CULT
WET LAB (2 PI's)
WET LAB (2 PI's)
AI
EQUIP.
HIST
AUTO
ANIM
LAB MGR.
GRADS / LAB TECHS
MIC.
COMP
FAC. OFF.
FAC. OFF.
COLLABORATION
FAC. OFF.
FAC. OFF.
Core Laboratory Support (shared by floor)
DIRECT CONNECTION
INDIRECT CONNECTION
BARRIER
TRANSPARENCY
ENTRY

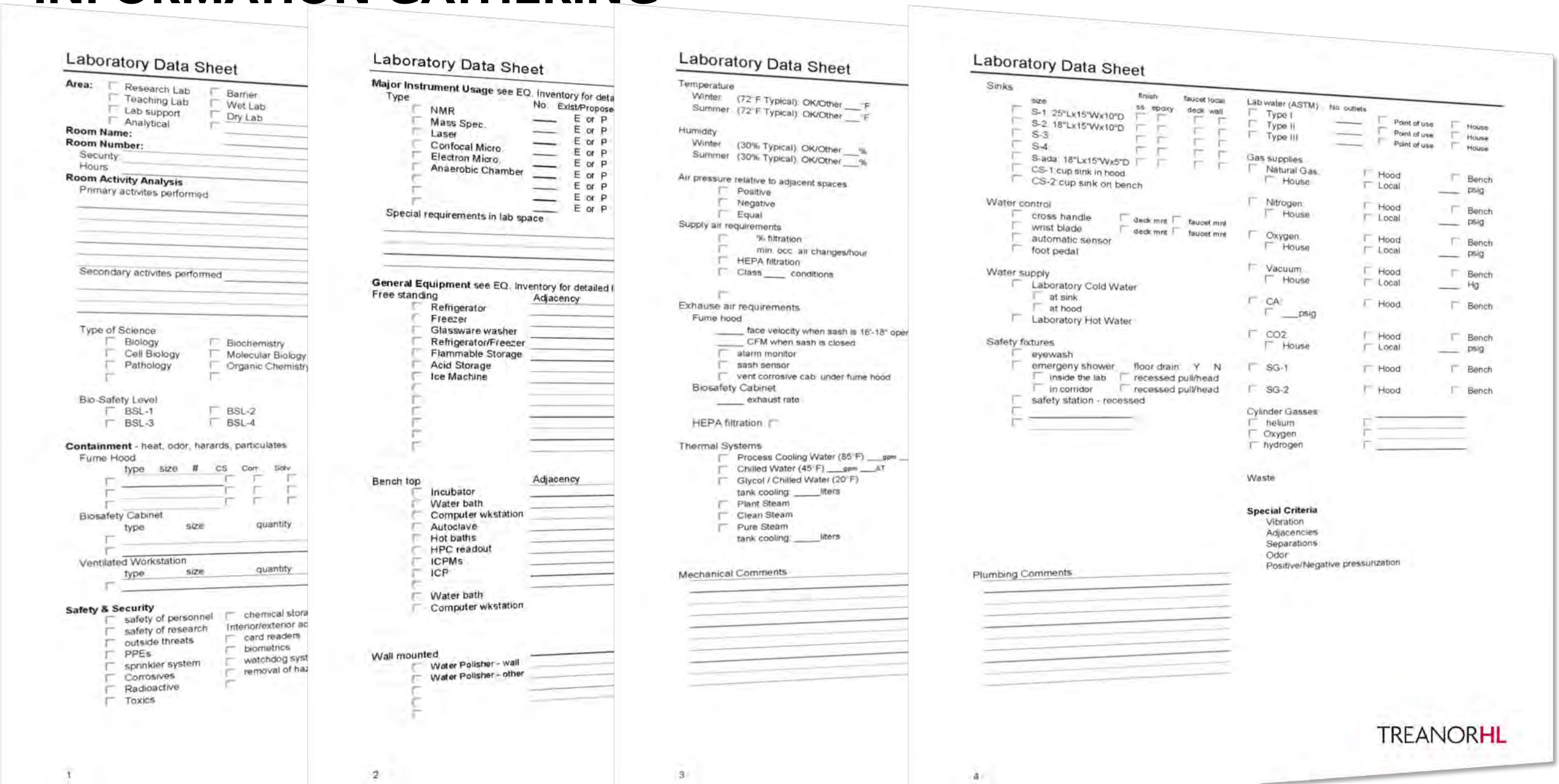
PR 124 ft²
PR 124 ft²
PR 124 ft²
PR 124 ft²
AHR 250 ft²
ANTE 79 ft²
ANTE 79 ft²
AHR 250 ft²
AHR 250 ft²
ANTE 79 ft²
ANTE 79 ft²
AHR 250 ft²
EM. EGRESS 208 ft²
PR 124 ft²
PR 124 ft²
PR 124 ft²
AHR 250 ft²
ANTE 79 ft²
ANTE 79 ft²
AHR 250 ft²
AHR 250 ft²
ANTE 79 ft²
JAN 70 ft²
ANTE 79 ft²
PR 124 ft²
CELL CULT. 228 ft²
MICRO INJEC. 196 ft²
EQUIP. AIR LOCK 103 ft²
PERSONNEL AIR LOCK 181 ft²
STER. 48 ft²
CLEAN CAGE WASH 1188 ft²
DIRTY CAGE WASH 1237 ft²
STER. 49 ft²
PERSONNEL AIR LOCK 186 ft²
NECROPSY 186 ft²
EQUIP AIR LOCK 110 ft²
AHR 250 ft²
BREAK ROOM 244 ft²
NECROPSY 150 ft²
PREP/GENO 447 ft²
JAN 110 ft²
AIR LOCK ENTRY 87 ft²
LAUNDRY 107 ft²
LOCKER 344 ft²
LOCKER 344 ft²
AHR 250 ft²
ANTE 79 ft²
ANTE 79 ft²
AHR 250 ft²
PR 124 ft²
PR 124 ft²
FEED & BEDDING 170 ft²
SUPPLY STOR. 170 ft²
OFFICE 112 ft²
AIR LOCK ENTRY 112 ft²


PROC
DARK
AHR
AHR
PROC
DARK
AHR
PROC
DARK
PROC
DARK
AHR
PROC
DARK
AHR
AHR
PROC
DARK
AHR
DARK
PROC
CELL CULT.
MICRO. INJECT.
PEOPLE
AIRLOCK EXIT
PEOPLE
AIRLOCK
ENTRY
EQUIP
STER.
EQUIP
EQUIP
PREP/GENO
STAGING
CLEAN CAGE WASH
DIRTY CAGE WASH
RACKS
EQUIP
PEOPLE
BIO BUBBLE
STER.
ENTRY DIRTY
NECROPSY
JAN.
JAN.
STAGING
ENTRY CLEAN
NECRO PSY
EQUIP
EQUIP
PEOPLE
LOCKERS
LOCKERS
BREAK ROOM
AHR
PROC
PROC
AHR
BED- DING
FEED
SUP- PLY
OFFICE


HIGH
LOW
Security
As security goes up...
PRIVATE
Research laboratories
SEMI-PRIVATE
Instructional laboratories
PUBLIC
Classrooms, informal spaces
...access goes down
CLOSED
OPEN
Access


Class Laboratory
Classroom
Research
Student Success
Circulation
ROOF DECK
164'-8"
THIRD
148'-0"
SECOND
132'-0"
FIRST
116'-0"
GROUND
100'-0"

INFORMATION GATHERING



Laboratory Data Sheet

Area: Research Lab / Teaching Lab / Lab support / Analytical / Barrier / Wet Lab / Dry Lab

Room Name:

Room Number:

Security

Hours

Room Activity Analysis

Primary activites performed

Secondary activites performed

Type of Science
- Biology
- Cell Biology
- Pathology
- Biochemistry
- Molecular Biology
- Organic Chemistry

Bio-Safety Level
- BSL-1
- BSL-3
- BSL-2
- BSL-4

Containment - heat, odor, harards, particulates

Fume Hood

type size # CS Corr Solv

Biosafety Cabinet

type size quantity

Ventilated Workstation

type size quantity

Safety & Security
- safety of personnel
- safety of research
- outside threats
- PPEs
- sprinkler system
- Corrosives
- Radioactive
- Toxics
- chemical stora
- Interior/exterior ac
- card readers
- biometrics
- watchdog syst
- removal of haz

1

Laboratory Data Sheet

Major Instrument Usage see EQ. Inventory for deta

Type / No. / Exist/Propose
- NMR — E or P
- Mass Spec. — E or P
- Laser — E or P
- Confocal Micro — E or P
- Electron Micro. — E or P
- Anaerobic Chamber — E or P
- E or P
- E or P
- E or P

Special requirements in lab space

General Equipment see EQ. Inventory for detailed l

Free standing — Adjacency
- Refrigerator
- Freezer
- Glassware washer
- Refrigerator/Freezer
- Flammable Storage
- Acid Storage
- Ice Machine

Bench top — Adjacency
- Incubator
- Water bath
- Computer wkstation
- Autoclave
- Hot baths
- HPC readout
- ICPMs
- ICP
- Water bath
- Computer wkstation

Wall mounted
- Water Polisher - wall
- Water Polisher - other

2

Laboratory Data Sheet

Temperature

Winter (72°F Typical) OK/Other ___°F

Summer (72°F Typical) OK/Other ___°F

Humidity

Winter (30% Typical) OK/Other ___%

Summer (30% Typical) OK/Other ___%

Air pressure relative to adjacent spaces
- Positive
- Negative
- Equal

Supply air requirements
- % filtration
- min. occ. air changes/hour
- HEPA filtration
- Class ____ conditions

Exhause air requirements

Fume hood

____ face velocity when sash is 16"-18" oper

____ CFM when sash is closed
- alarm monitor
- sash sensor
- vent corrosive cab. under fume hood

Biosafety Cabinet

____ exhaust rate

HEPA filtration

Thermal Systems
- Process Cooling Water (85°F) ___gpm
- Chilled Water (45°F) ___gpm ___ΔT
- Glycol / Chilled Water (20°F)
- tank cooling: ____liters
- Plant Steam
- Clean Steam
- Pure Steam
- tank cooling: ____liters

Mechanical Comments

3

Laboratory Data Sheet

Sinks (size / finish: ss, epoxy / faucet local: deck, wall)
- S-1 25"Lx15"Wx10"D
- S-2 18"Lx15"Wx10"D
- S-3
- S-4
- S-ada 18"Lx15"Wx5"D
- CS-1 cup sink in hood
- CS-2 cup sink on bench

Water control
- cross handle
- wrist blade
- automatic sensor
- foot pedal
- deck mnt / faucet mnt
- deck mnt / faucet mnt

Water supply
- Laboratory Cold Water
  - at sink
  - at hood
- Laboratory Hot Water

Safety fixtures
- eyewash
- emergeny shower — floor drain Y N
  - inside the lab — recessed pull/head
  - in corridor — recessed pull/head
- safety station - recessed

Plumbing Comments

Lab water (ASTM) — No. outlets
- Type I — Point of use — House
- Type II — Point of use — House
- Type III — Point of use — House

Gas supplies
- Natural Gas — House — Hood — Local — Bench — psig
- Nitrogen — House — Hood — Local — Bench — psig
- Oxygen — House — Hood — Local — Bench — psig
- Vacuum — House — Hood — Local — Bench — Hg
- CA — ___psig — Hood — Bench
- CO2 — House — Hood — Local — Bench — psig
- SG-1 — Hood — Bench
- SG-2 — Hood — Bench

Cylinder Gasses
- helium
- Oxygen
- hydrogen

Waste

Special Criteria

Vibration

Adjacencies

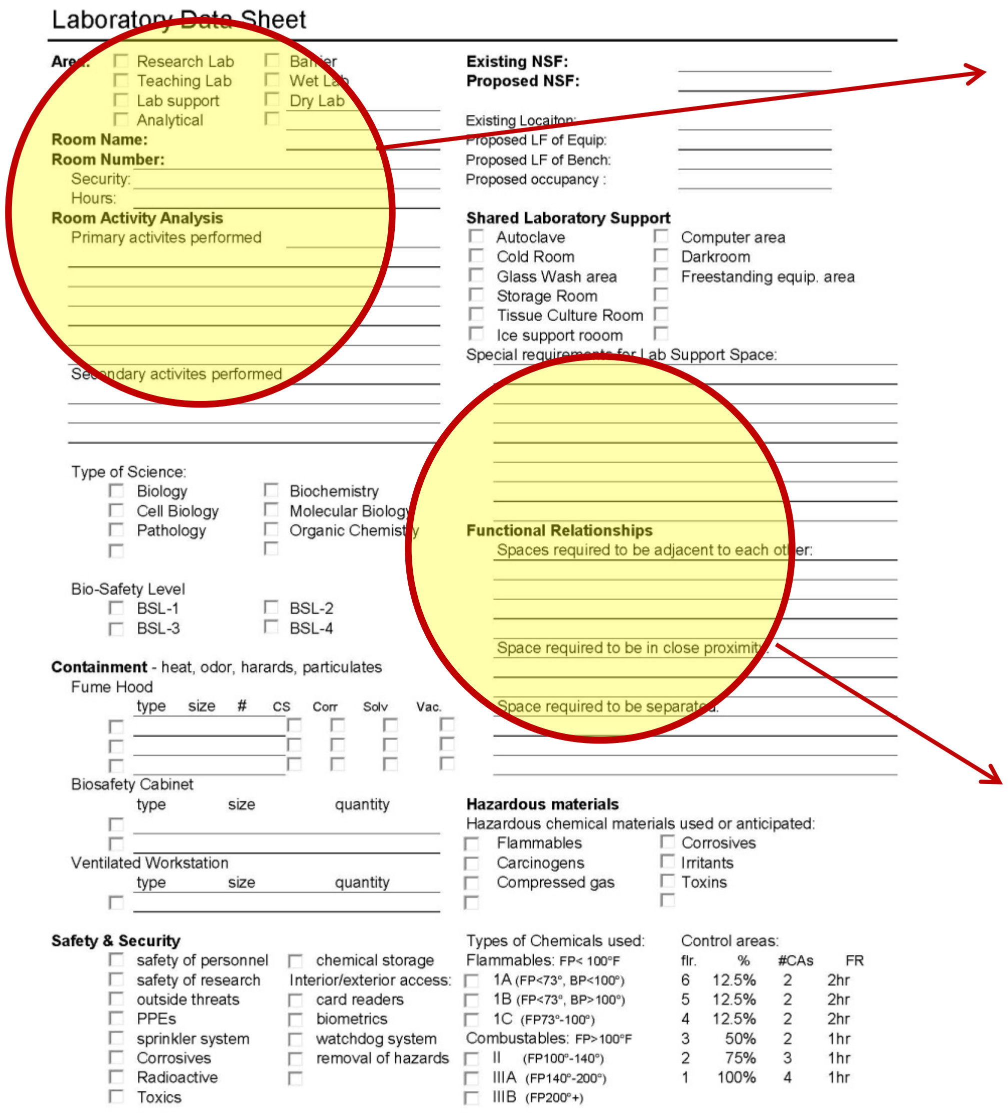
Separations

Odor

Positive/Negative pressurization

4

TREANORHL



Laboratory Data Sheet

Area: Research Lab / Teaching Lab / Lab support / Analytical / Barrier / Wet Lab / Dry Lab

Existing NSF:
Proposed NSF:

Room Name:
Room Number:
Security:
Hours:

Existing Locaiton:
Proposed LF of Equip:
Proposed LF of Bench:
Proposed occupancy :

Room Activity Analysis
Primary activites performed
Secondary activites performed

Shared Laboratory Support
Autoclave / Cold Room / Glass Wash area / Storage Room / Tissue Culture Room / Ice support rooom / Computer area / Darkroom / Freestanding equip. area
Special requirements for Lab Support Space:

Type of Science:
Biology / Cell Biology / Pathology / Biochemistry / Molecular Biology / Organic Chemistry

Functional Relationships
Spaces required to be adjacent to each other:
Space required to be in close proximity:
Space required to be separated:

Bio-Safety Level
BSL-1 / BSL-2 / BSL-3 / BSL-4

Containment - heat, odor, harards, particulates
Fume Hood
type size # CS Corr Solv Vac.

Biosafety Cabinet
type size quantity

Ventilated Workstation
type size quantity

Hazardous materials
Hazardous chemical materials used or anticipated:
Flammables / Carcinogens / Compressed gas / Corrosives / Irritants / Toxins

Safety & Security
safety of personnel / safety of research / outside threats / PPEs / sprinkler system / Corrosives / Radioactive / Toxics
chemical storage
Interior/exterior access: card readers / biometrics / watchdog system / removal of hazards

Types of Chemicals used:
Flammables: FP< 100°F
1A (FP<73°, BP<100°)
1B (FP<73°, BP>100°)
1C (FP73°-100°)
Combustables: FP>100°F
II (FP100°-140°)
IIIA (FP140°-200°)
IIIB (FP200°+)

Control areas:

flr.	%	#CAs	FR
6	12.5%	2	2hr
5	12.5%	2	2hr
4	12.5%	2	2hr
3	50%	2	1hr
2	75%	3	1hr
1	100%	4	1hr

TREANORHL

General

- Type of space
- Area / sq ft
- Activities/users
- Special requirements (vibration, acoustics, etc…)

Functional Relationships

- Adjacencies
- Separations
- Hazards

Laboratory Data Sheet

Area:
- ☐ Research Lab
- ☐ Teaching Lab
- ☐ Lab support
- ☐ Analytical
- ☐ Barrier
- ☐ Wet Lab
- ☐ Dry Lab
- ☐

Room Name:

Room Number:

Security:

Hours:

Room Activity Analysis

Primary activites performed

Secondary activites performed

Type of Science:
- ☐ Biology
- ☐ Cell Biology
- ☐ Pathology
- ☐
- ☐ Biochemistry
- ☐ Molecular Biology
- ☐ Organic Chemistry
- ☐

Bio-Safety Level
- ☐ BSL-1
- ☐ BSL-3
- ☐ BSL-2
- ☐ BSL-4

Containment - heat, odor, harards, particulates

Fume Hood

	type	size	#	CS	Corr	Solv	Vac.
☐				☐	☐	☐	☐
☐				☐	☐	☐	☐
☐				☐	☐	☐	☐

Biosafety Cabinet

	type	size	quantity
☐			
☐			

Ventilated Workstation

	type	size	quantity
☐			

Safety & Security
- ☐ safety of personnel
- ☐ safety of research
- ☐ outside threats
- ☐ PPEs
- ☐ sprinkler system
- ☐ Corrosives
- ☐ Radioactive
- ☐ Toxics
- ☐ chemical storage

Interior/exterior access:
- ☐ card readers
- ☐ biometrics
- ☐ watchdog system
- ☐ removal of hazards
- ☐

Existing NSF:

Proposed NSF:

Existing Locaiton:

Proposed LF of Equip:

Proposed LF of Bench:

Proposed occupancy :

Shared Laboratory Support
- ☐ Autoclave
- ☐ Cold Room
- ☐ Glass Wash area
- ☐ Storage Room
- ☐ Tissue Culture Room
- ☐ Ice support rooom
- ☐ Computer area
- ☐ Darkroom
- ☐ Freestanding equip. area
- ☐
- ☐
- ☐

Special requirements for Lab Support Space:

Functional Relationships

Spaces required to be adjacent to each other:

Space required to be in close proximity:

Space required to be separated:

Hazardous materials

Hazardous chemical materials used or anticipated:
- ☐ Flammables
- ☐ Carcinogens
- ☐ Compressed gas
- ☐
- ☐ Corrosives
- ☐ Irritants
- ☐ Toxins
- ☐

Types of Chemicals used:	Control areas:			
Flammables: FP< 100°F	flr.	%	#C/e	FR
☐ 1A (FP<73°, BP<100°)	6	12.5%	2	2hr
☐ 1B (FP<73°, BP>100°)	5	12.5%	2	2hr
☐ 1C (FP73°-100°)	4	12.5%	2	2hr
Combustables: FP>100°F	3	50%	1	1hr
☐ II (FP100°-140°)	2	75%	3	1hr
☐ IIIA (FP140°-200°)	1	100%	4	1hr
☐ IIIB (FP200°+)				

Laboratory Data Sheet

Temperature
Winter (72°F Typical): OK/Other ___°F
Summer (72°F Typical): OK/Other ___°F

Humidity
Winter (30% Typical): OK/Other ___%
Summer (30% Typical): OK/Other ___%

Air pressure relative to adjacent spaces
☐ Positive
☐ Negative
☐ Equal

Supply air requirements
☐ % filtration
☐ min. occ. air changes/hour
☐ HEPA filtration
☐ Class ____ conditions
☐

Exhaust air requirements
Fume hood
_____ face velocity when sash is 16'-18" open
_____ CFM when sash is closed
☐ alarm monitor
☐ sash sensor
☐ vent corrosive cab. under fume hood
Biosafety Cabinet
_____ exhaust rate

HEPA filtration ☐

Thermal Systems
☐ Process Cooling Water (85°F) ___gpm ___ΔT
☐ Chilled Water (45°F) ___gpm ___ΔT
☐ Glycol / Chilled Water (20°F)
tank cooling: _____liters
☐ Plant Steam
☐ Clean Steam
☐ Pure Steam
tank cooling: _____liters

Mechanical Comments ______

120 V - 1 f
☐ Normal raceway: __" O.C. ☐ Standby raceway: __" O.C.
___No. outlets per room ___No. outlets per room
208 V - 1 f
☐ Normal ☐ Standby
___No. outlets per room
208 V - 3 f
☐ Normal ☐ Standby
___No. outlets per room
480 V - 3 f
☐ Normal ☐ Standby
___No. outlets per room

☐ Dedicated Circuit
_______Quantity _______ Volt/Amp.
Serve:

☐ UPS: OFOI or CFCI
☐ Hard connection for BSCs
☐ Outlet for BSCs

Illumination Level
Office
average fc:
task fc:
Lab
average fc:
task fc:
☐ Special illumination

☐ Dark room light:
☐

Communication
☐ Computer Outlet
4-Plex
Duplex
Other
Locations

☐ Telephone
☐ Paging
☐

Electrical Comments ______

Building Systems

- Temperature
- Humidity
- Air pressurization
- Power requirements
- Light levels
- Communication and Technology

Project #

LABORATORY EQUIPMENT UTILITY SCHEDULE

TREANORHL

Project # Date

NOTE: INFORMATION PROVIDED BY THE OWNER FOR OWNER FURNISHED EQUIPMENT. CONTRACTOR IS TO VERIFY FOR EQUIPMENT INSTALLED BY CONTRACTOR.

Equipment No.	EQUIPMENT: equipment name	EQUIPMENT: mfr/model no.	PHYSICAL ATTRIBUTES: (F)loor or (B)enchtop	PHYSICAL ATTRIBUTES: SIZE WxDxH (FT)	PHYSICAL ATTRIBUTES: ACCESS LxW (FT)	SOURCE: Existing (E)	SOURCE: New (N)	SOURCE: Owner/Contractor furnished by	SOURCE: Owner/Contractor installed by
1									
2									
3									
4									

Equipment No.	BUILDING PIPED UTILITIES: RO DI flow GPM	RO DI pipe size IN	PCWSR flow GPM	PCWSR pipe size IN	HW flow GPM	HW pipe size IN	CW flow GPM	CW pipe size IN	CW turret or hose bib	CA flow GPM	CA pipe size IN	LV flow GPM	LV pipe size IN	GAS flow GPM	GAS pipe size IN	DRAIN Y/N
1																
2																
3																
4																

Equipment No.	SPECIALTY GAS (cylinders): Type	flow	pipe size [illegible]	purity [illegible]	EQ. EXHAUST: remove heat odor	flow cfm	duct size IN	static pressure IN W.C.	ELECTRICAL: volts V	amps A	phase ø	power kVA	disconnect size amps	plug type NEMA	emerg power	DATA qty	SPECIAL CRITERIA: [illegible]	SPECIAL CRITERIA: light sensitive
1																		
2																		
3																		
4																		

Major equipment impact:

- Physical space (size)
- Adjacent areas (location)
- Building systems
- Vibration – producing or sensitive
- EMI – producing or sensitive

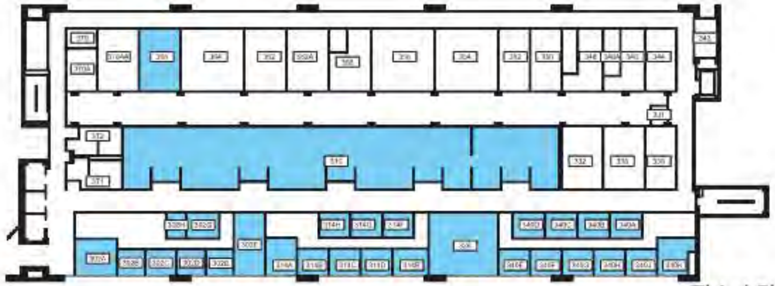
Backfill space

AVAILABLE SF

Basement Floor:	5,444 ft^2
First Floor:	5,133 ft^2
Second Floor:	1,072 ft^2
Third Floor:	7,900 ft^2
Fourth Floor:	9,713 ft^2
TOTAL SF:	**29,262** ft^2

Fourth Floor

First Floor



Third Floor

Basement Floor

Second Floor

Classrooms with tablet arm chairs:

- KI: 16 to 19 sq ft / student
- Steelcase: 17 sq ft /student
- Our team: 16 to 20 sq ft / student

Classrooms with continuous tables & chairs:

- KI: 17 to 22 sq ft / student
- Steelcase: 16 to 27 sq ft / student
- Our team: 20 to 25 sq ft / student

Active learning environments with moveable furniture

- KI: 22 to 32 sq ft / student
- Steelcase: 24 to 31 sq ft / student
- Our team: 24 to 30 sq ft / student

Classroom utilization

- Usually based on **40 to 50 hour weeks**
- Typical range **50 to 80%**
- Average occupancy **60 to 80%**
- Cost of classrooms outfitted with technology **$350-$450 / sf**

Instructional laboratory utilization

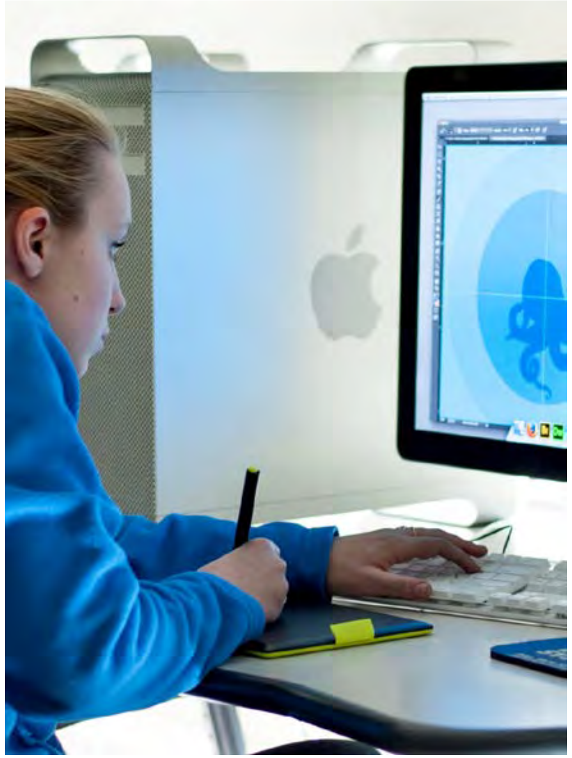
- Usually based on
  40 to 50 hour weeks
- Typical range
  25 to 55%
- Average occupancy
  30 to 80%
- Cost of instructional laboratorie
  outfitted with technology
  $500-$650 / sf

Individual Class Labs:

- Biomedical Engineering, Mechanics of Materials, Hydrology, Fluid Mechanics, Thermodynamics, Automation and Controls, Robotics, HVAC, Lighting, Electronics, Environmental…
- General Biology, Molecular Biology, Microbiology, Genetics, Marine Biology, Plant Biology, Cell Biology, Physiology and Anatomy, Ecology, Histology and Cytology, Neurobiology…
- General Chemistry, Organic Chemistry, Biochemistry, Analytical Chemistry, Physical Chemistry, Inorganic Chemistry…

3.

Trends



Instructional Laboratories


XStream
XStream
FLAMMABLE
KEEP FIRE AWAY
LFK
HOT BOX COOKIES
got science?


XStream


Tasks for Today
1. Complete Total/Dissolved N Measurements
2. Prepare Total & Dissolved P Samples
3. Alkalinity Measurements
4. Water Hardness Solution

Research Laboratories & Core Facilities

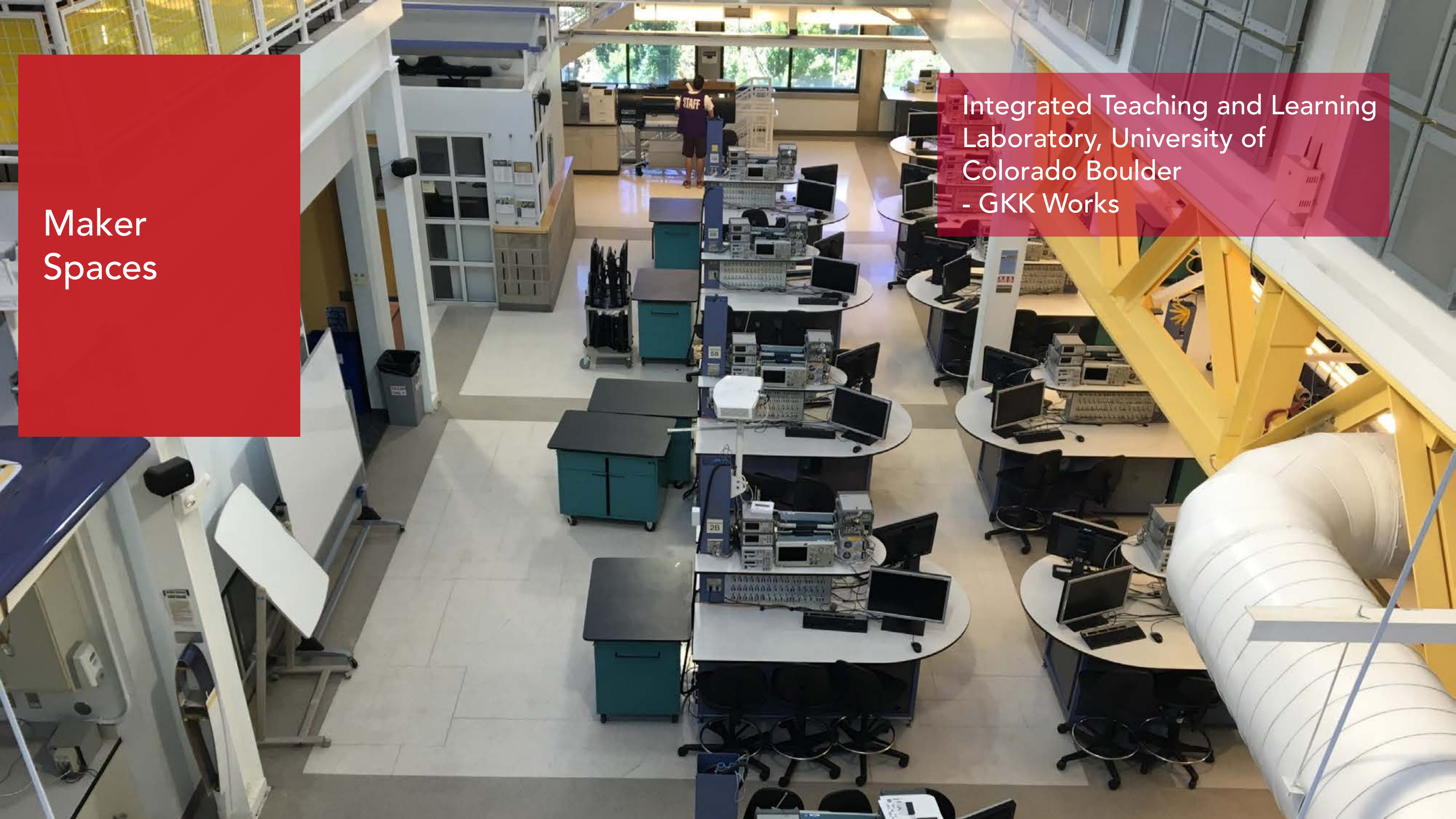

FIRE SPRINKLER WATER


EXIT


BIOFUELS


OMi
JLG LIFT

Maker Spaces



Integrated Teaching and Learning Laboratory, University of Colorado Boulder
- GKK Works

ExxonMobil Lawrence G. Rawl
Engineering Practice Facility,
University of Oklahoma
- Miles Associates

EPIC
(Engineering Product Innovation Center)
Boston University
- Wilson Architects

Classrooms


EXIT
Meyer Music
Music
Smarter


Gatorade


ADC -- Multiple Samples Exercise
Design a function to collect multiple samples from an ADC
Write pseudo-code or draw a flow chart for your function
When your function is called:
Initialize ADC0, Sequencer 0, and collect data from Analog Input #1
Collect 100 samples spaced 1 mS apart (1 mS sample interval)
Report sample values using "printf" or equivalent and serial communications to the PC
Information and Telecommunication Technology Center
KU THE UNIVERSITY OF KANSAS
wacom


ADC – Multiple Samples Exercise
CAREER


ADC -- Multiple Samples Exercise


ELEVATOR
EXIT
CLASSROOM
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Take-aways

Project planning and programming is the first, and most important step in the design process

Programming is a collaborative process that translates stakeholder wants and needs into a useable facility

Design professionals are not dictators but facilitators; they use tools, strategies and trends to inform and guide