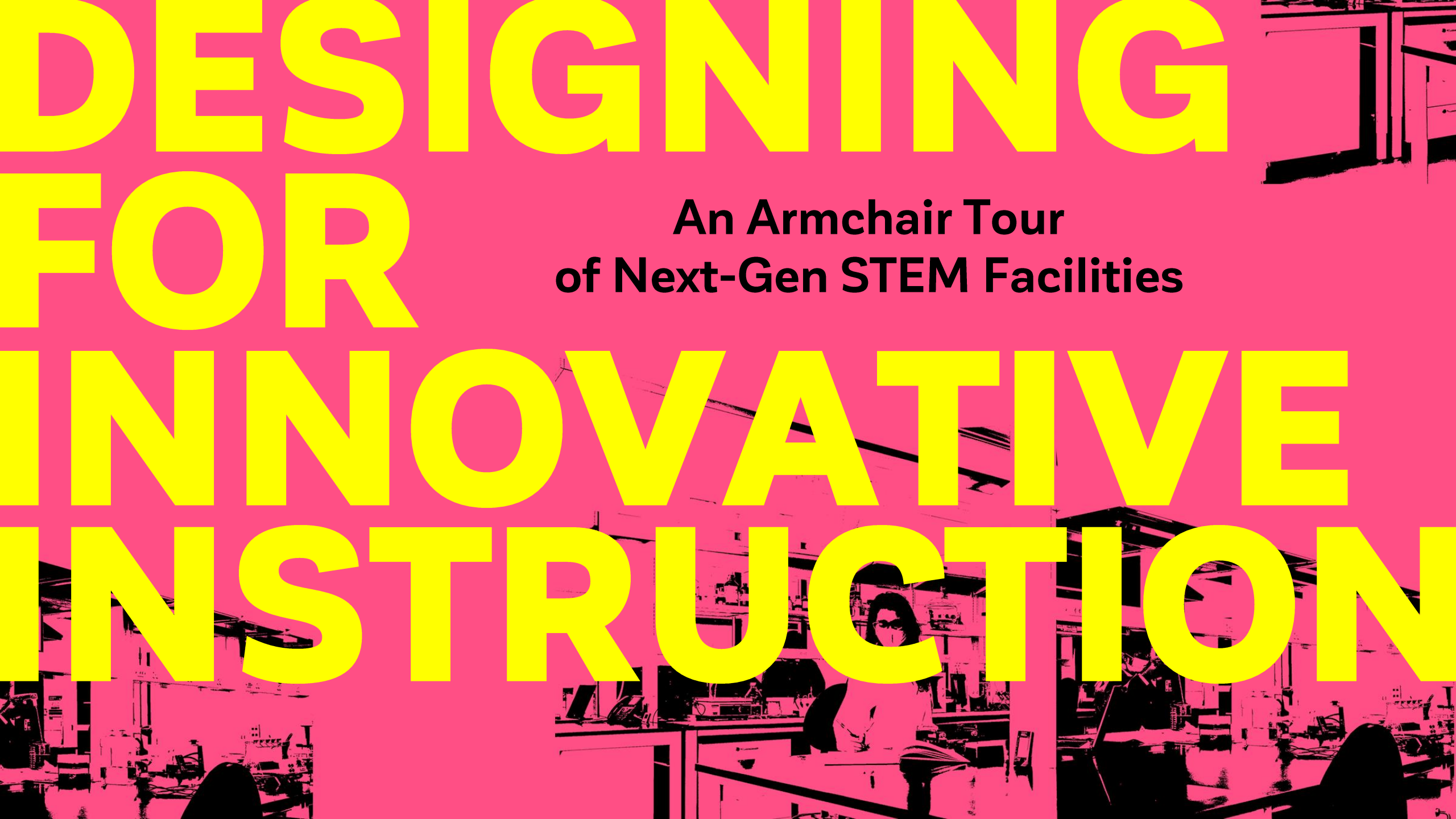


DESIGNING FOR INNOVATIVE INSTRUCTION

An Armchair Tour
of Next-Gen STEM Facilities





**STEPHEN
BARTLETT**



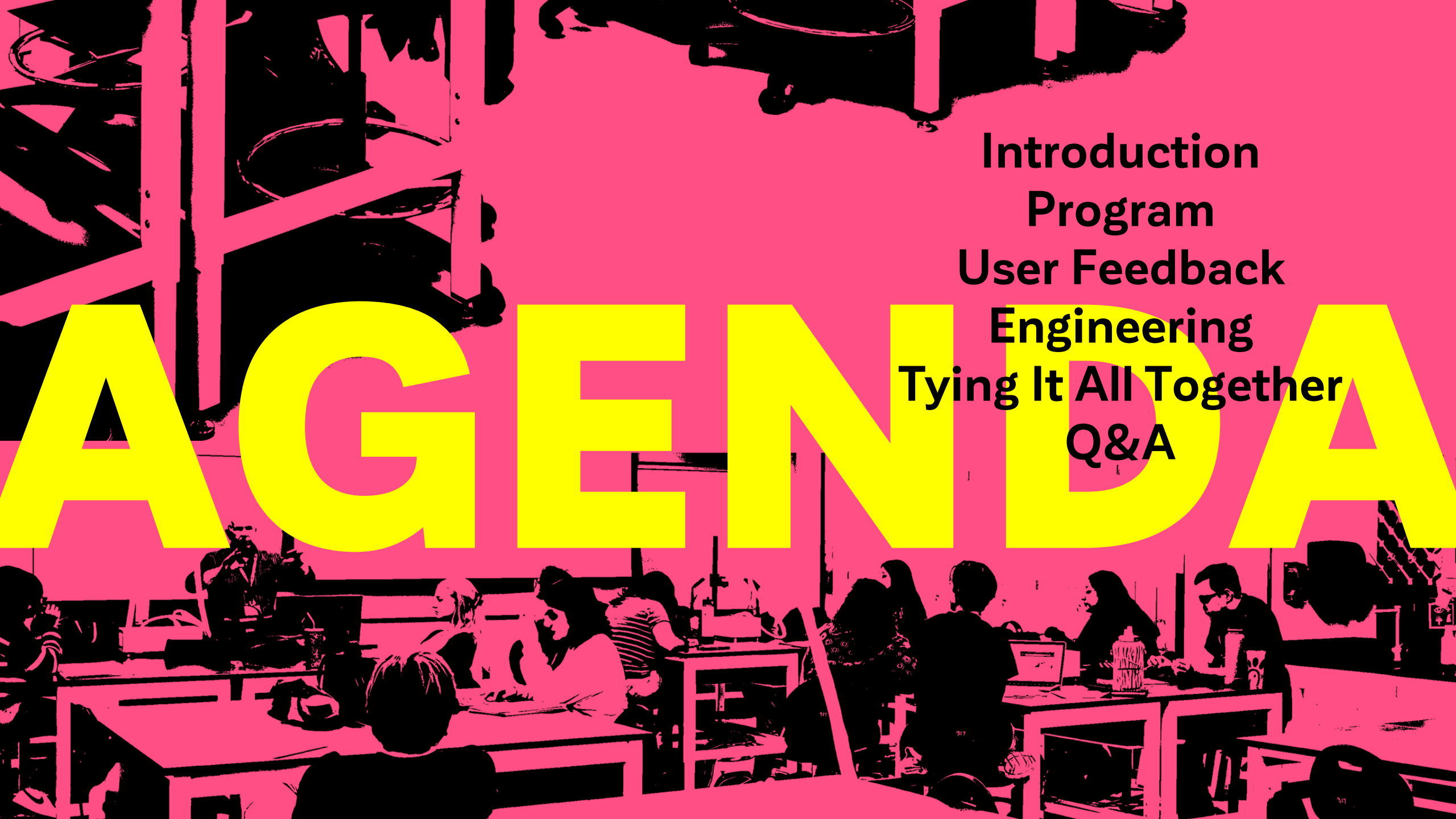
**KATHERINE
WOHLSEN**



**BRAD
CROWLEY**



**LAUREN
BAILEY**



AGENDA

- Introduction
- Program
- User Feedback
- Engineering
- Tying It All Together
- Q&A

A photograph of a classroom filled with students. In the foreground, a student with dark hair is seen from the back, sitting at a desk. To the left, another student is leaning over a desk, possibly talking to a peer. In the middle ground, several students are seated at desks, some looking towards the camera and others at their work. A teacher, a woman with dark hair, is standing in the center-right, leaning over a desk and talking to a student. The classroom has large windows on the left side, letting in natural light. There are various items on the desks, including papers, pens, and a water bottle. The overall atmosphere is one of active learning and collaboration.

INTRODUCTION

MULTI-DISCIPLINARY

Enhance Broader Exposure



STEM BUILDING Virginia Commonwealth University

STUDENT-CENTRIC HUBS

Location Needs to Foster Student Access



SHARED RESOURCES

Foster Institutional Identity



FULL TIME OCCUPANTS

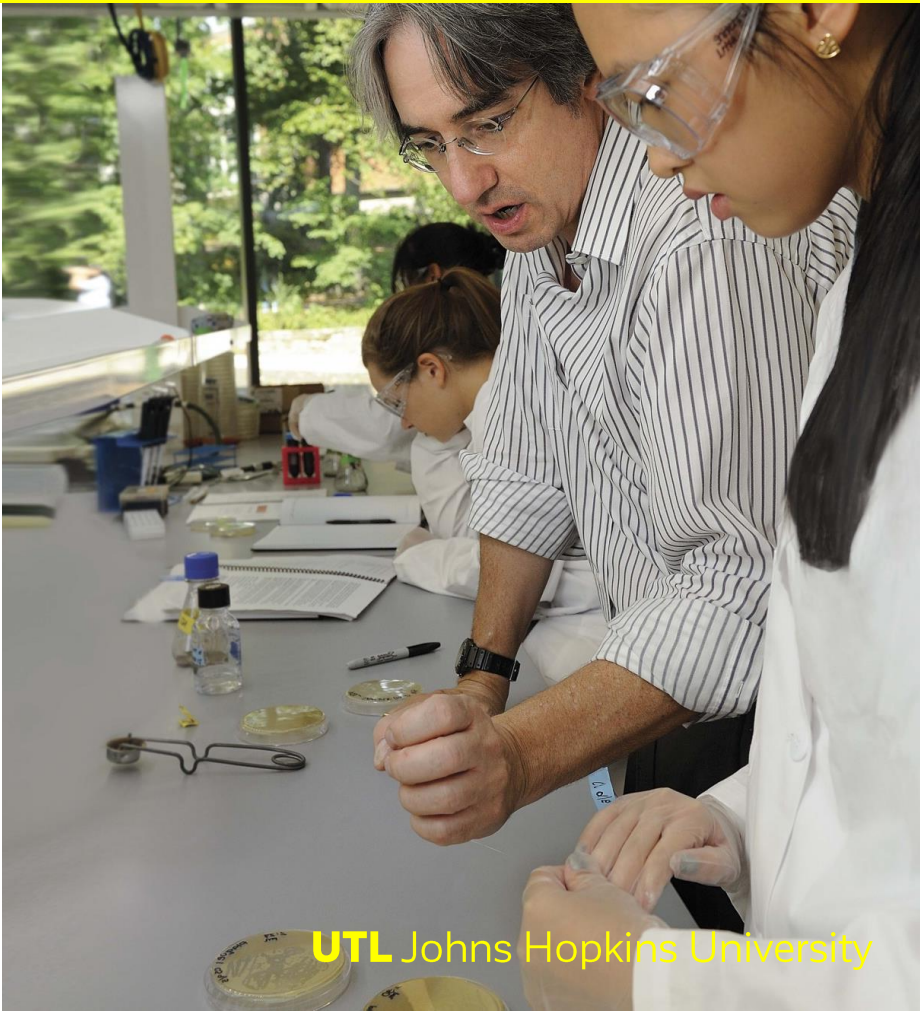
Reinforce Space Ownership



STEM BUILDING Virginia Commonwealth University

BIFURCATE STUDENT EXPERIENCE

Intro vs. Advanced Courses



MAC BUILDING Berea College



UTL Johns Hopkins University



KIEWIT HALL University of Nebraska-Lincoln



STEM BUILDING Virginia Commonwealth University



UTL

Johns Hopkins University

LOCATION Baltimore, MD

YEAR 2017

COST \$62M

SIZE 103,000 SF

DEPARTMENTS 4





Showcases
Teaching Labs

Expands Research in
Vacated Backfill

Teaching Faculty
Offices in Building:
Proximate to Students

Natural Science Commons:
Hub for Student and Faculty
Interaction

Equipment Core Labs

Student Project Labs

MAC BUILDING

Berea College

LOCATION Berea, KY
YEAR 2018
COST \$72M
SIZE 125,000 SF
DEPARTMENTS 5





Teaching - centric program:
limited research

Strategic combination of
Natural and Health Science

Replaces antiquated
facilities: evolved from
addition/renovation to new
building

Includes project labs for
faculty + student research

KIEWIT HALL

University of Nebraska-Lincoln

LOCATION Lincoln, NE

YEAR 2024

COST \$115M

SIZE 182,000 SF

DEPARTMENTS 15





**Co-Locates All
Engineering Disciplines
Teaching**

**School Flagship: Leadership
+ Large Central Space + All-
school Activities**

**Labs, Classrooms, Project
Space, Food Service, Study,
Shops**

Includes Student Services

**Creates Physical Gateway to
Engineering School**

STEM BUILDING

Virginia Commonwealth University

LOCATION Richmond, VA

YEAR 2023

COST \$124M

SIZE 168,000 SF

DEPARTMENTS 17





Collocates 9 Disciplines; 32 Teaching Labs

Science Learning Center

Expands Research in Vacated Backfill

Program Flexibility:
Kinesiology, Anthropology,
Forensics

Faculty Offices Remain in
Departmental Buildings

MAC BUILDING Berea College

MULTI-DISCIPLINARY



UTL Johns Hopkins University

SHARED RESOURCES



KIEWIT HALL University of Nebraska-Lincoln

INSTITUTIONAL IDENTITY



STEM BUILDING Virginia Commonwealth University

STUDENT CENTRIC





PROGRAM

PROCESS



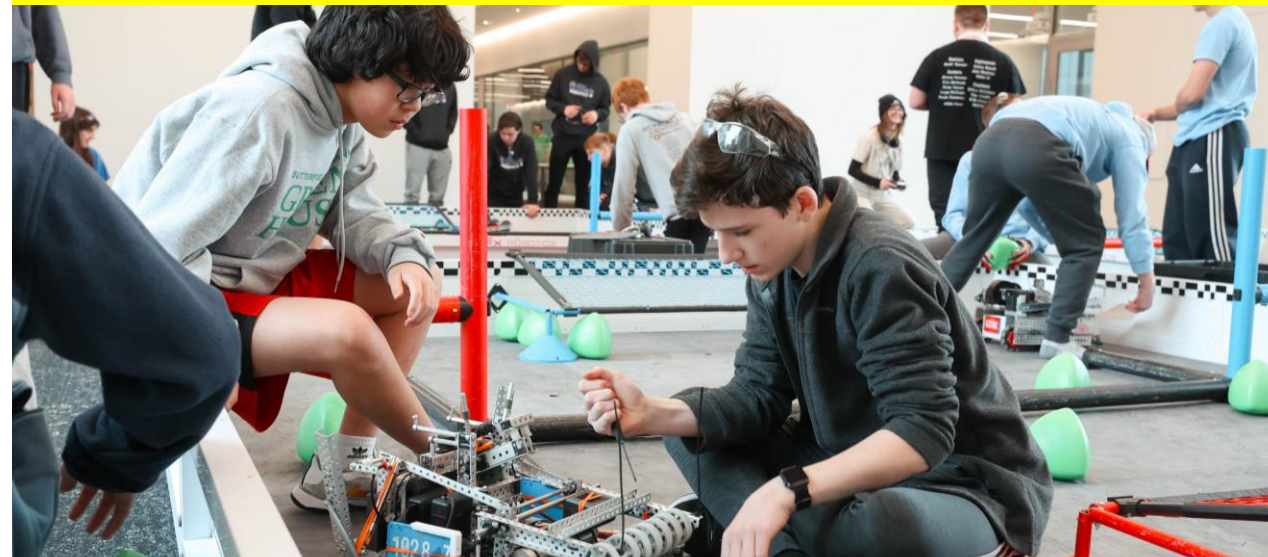
FLEXIBILITY



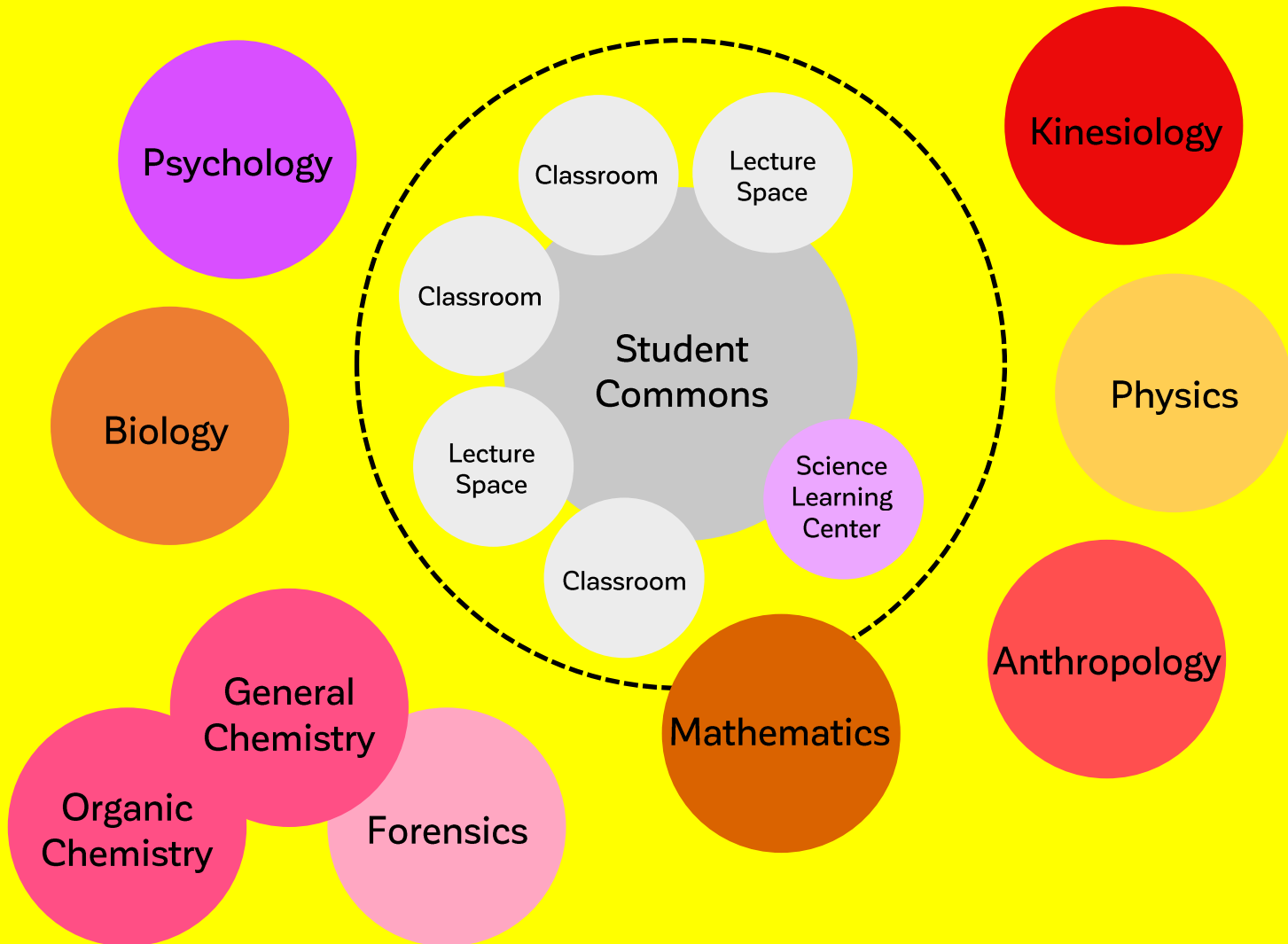
SAFETY



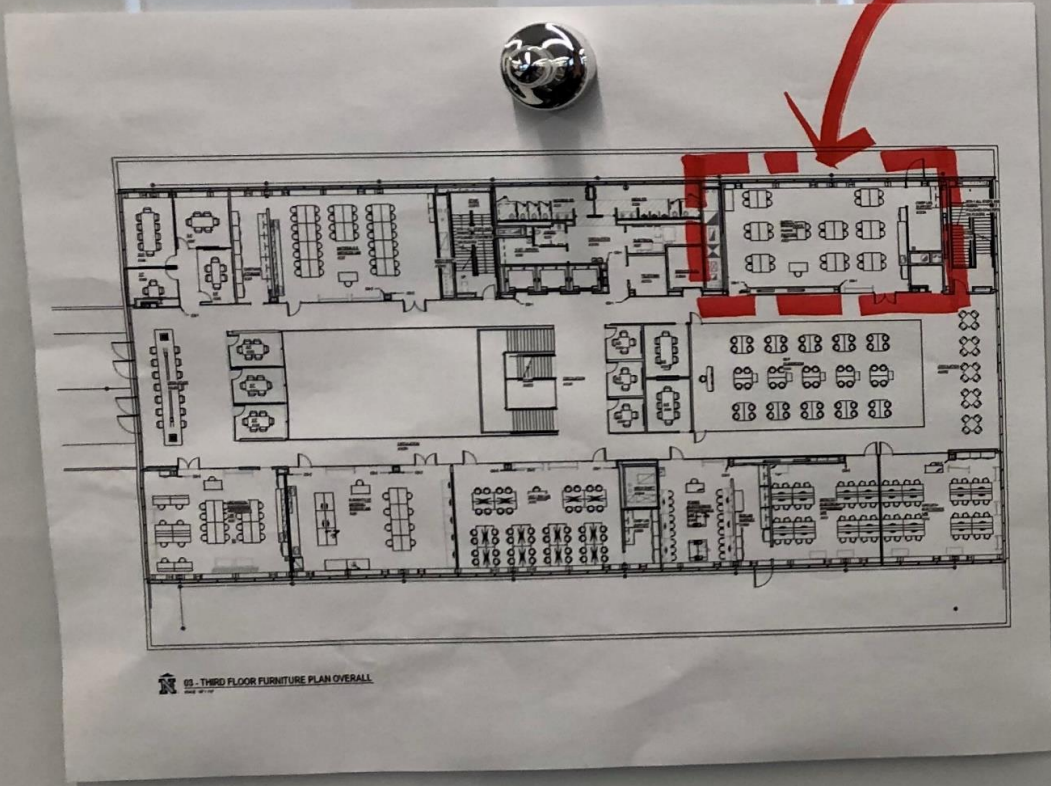
COMMUNITY



PROCESS



FLEXIBILITY



This is the layout for best use of space

← Nuh uh



MAC Building - Organic Chemistry Lab Berea College

Blended Classroom – Laboratory

Highly Flexible Laboratory Furnishings

Full Teaching Wall and Audio-Visual

Transparency





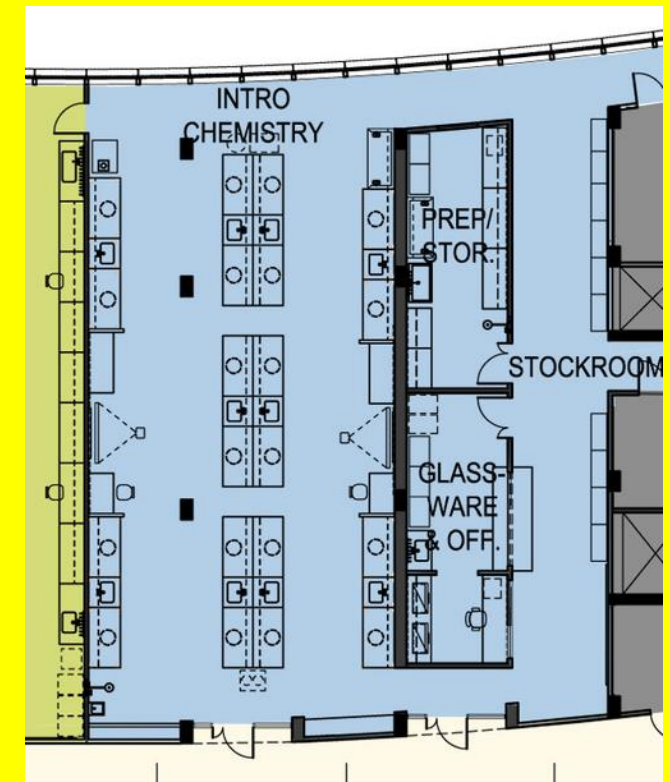
UTL - Introductory Chemistry Lab Johns Hopkins University

High-Throughput Laboratory

Minimal In-Lab Instruction / AV

Consistent Curriculum

Fixed Laboratory Furnishings



TEACHING WET LAB



NURSING CLINICAL SKILLS LAB



FORENSICS CRIME SCENE



EXERCISE SCIENCE LAB



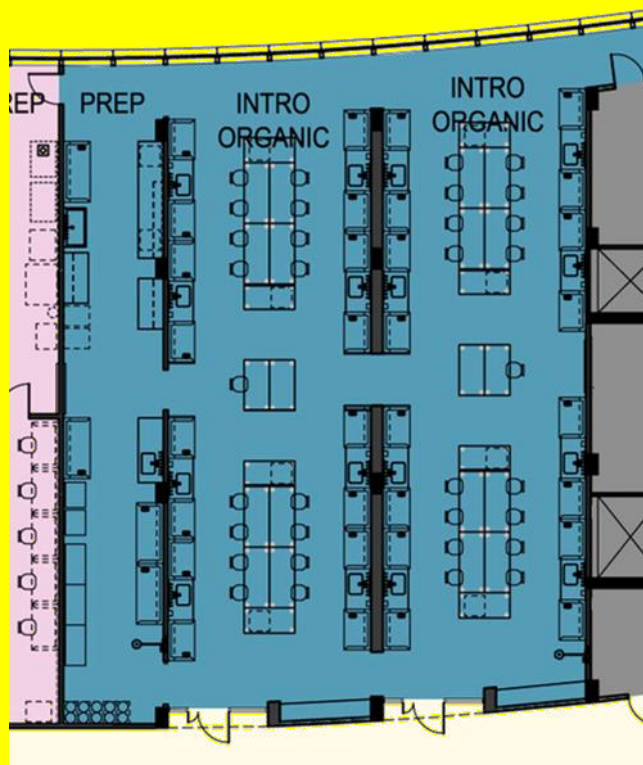
SAFETY

Clear Zoning in Lab

Circulation to Minimize Cross-Traffic

Hood-Per-Student, With Elbow Room

Sightlines Within and Between Labs



CUBBIES



American University

SAFETY STATIONS



Virginia Commonwealth University

DRINKS SHELVES



Swarthmore College

COMMUNITY

Support Student Success

Home / Hub

Destinations / Draws

Student Services

Social Spaces



Kiewit Hall – Atrium + Stair University of Nebraska - Lincoln



Kiewit Hall – Clubs University of Nebraska - Lincoln



Kiewit Hall – Garage University of Nebraska - Lincoln



STEM Building – Math Exchange Virginia Commonwealth University

**200-SEAT
LECTURE HALL**

COMMONS

**200-SEAT
LECTURE HALL**

**SCIENCE
LEARNING CENTER**



STEM Building – Student Commons Virginia Commonwealth University

STUDENT-CENTRIC HUB

Look Good, Feel Good / Clean, Bright, Daylit



STEM BUILDING Virginia Commonwealth University

IMPACTS ON LEARNING

Attendance is Better / Team-Based Approach



MATH EXCHANGE

No Phones! / Writable Walls



STEM BUILDING Virginia Commonwealth University

SCIENCE LEARNING CENTER

Welcoming / Faculty Office Hours

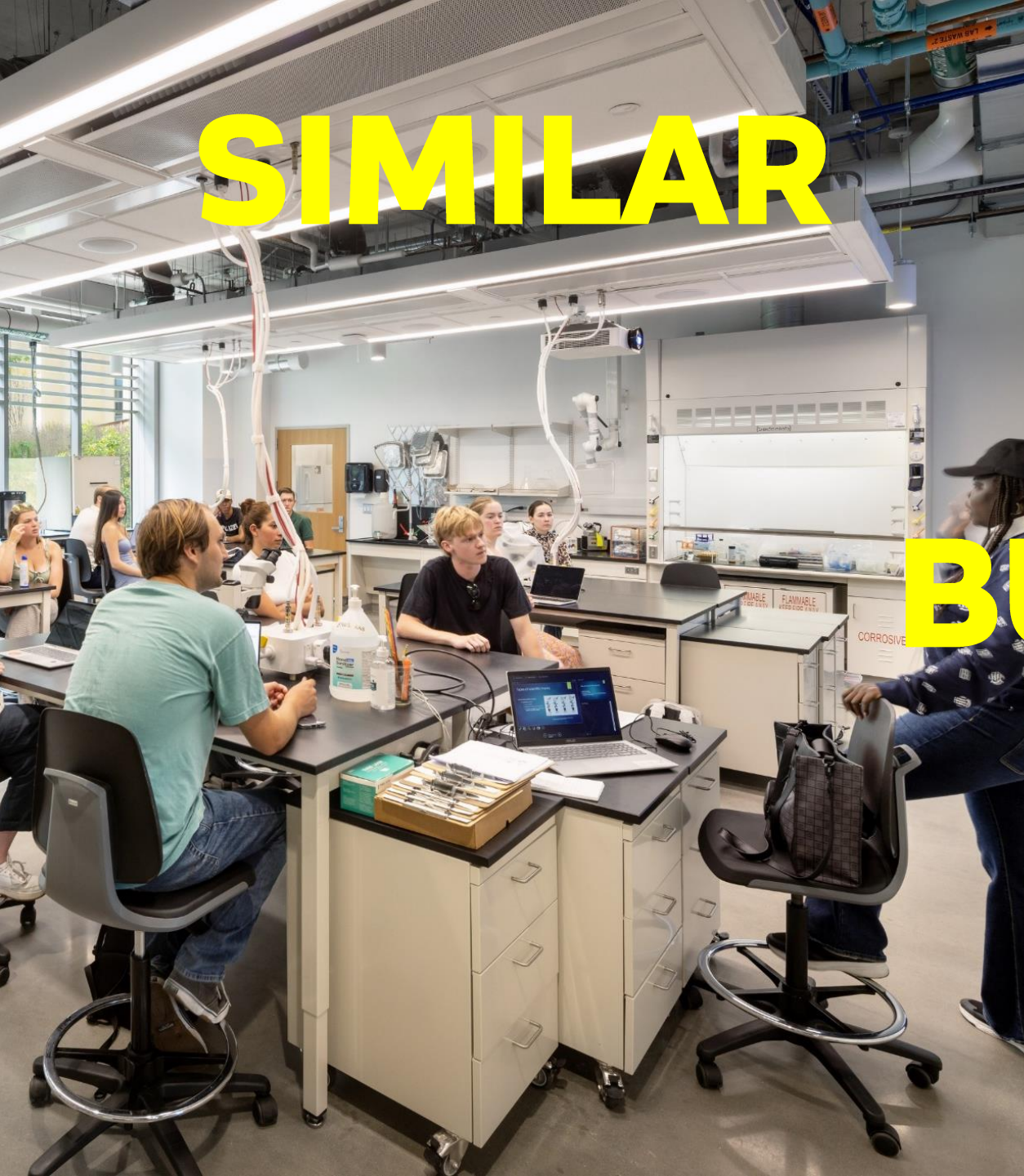


STEM BUILDING Virginia Commonwealth University



ENGINEERING

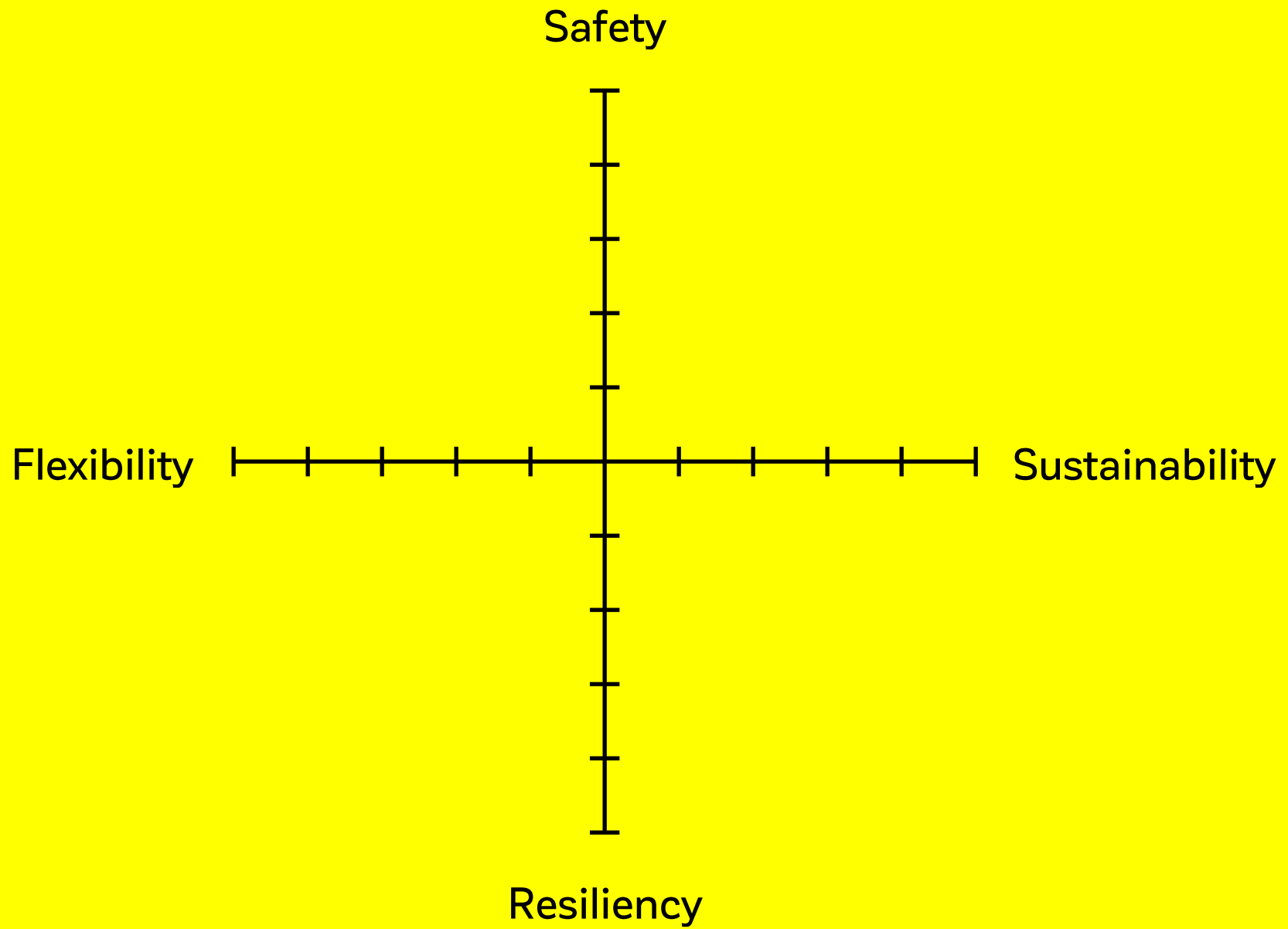
SIMILAR



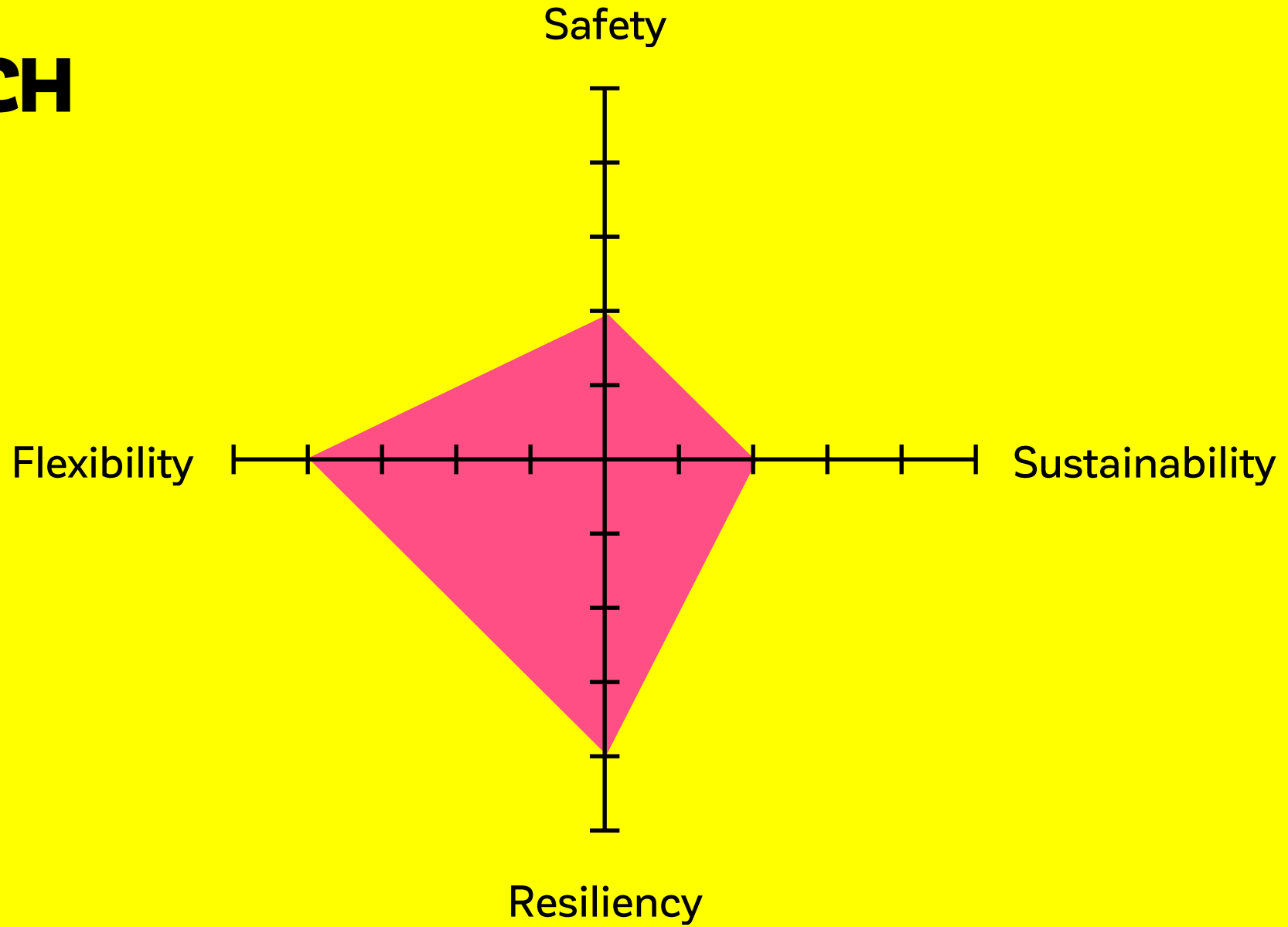
BUT



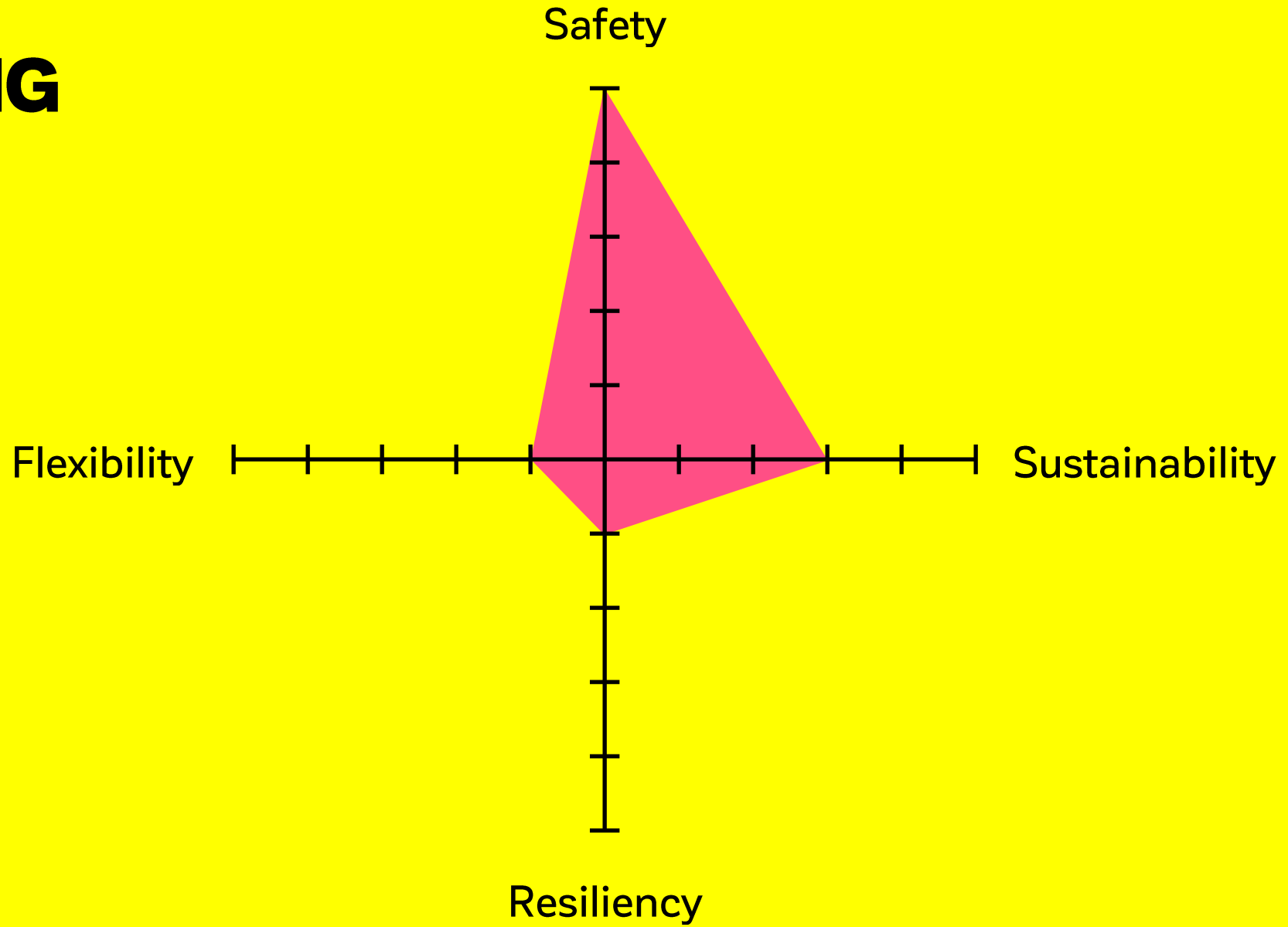
DIFFERENT



RESEARCH



TEACHING



2000CFM



TO

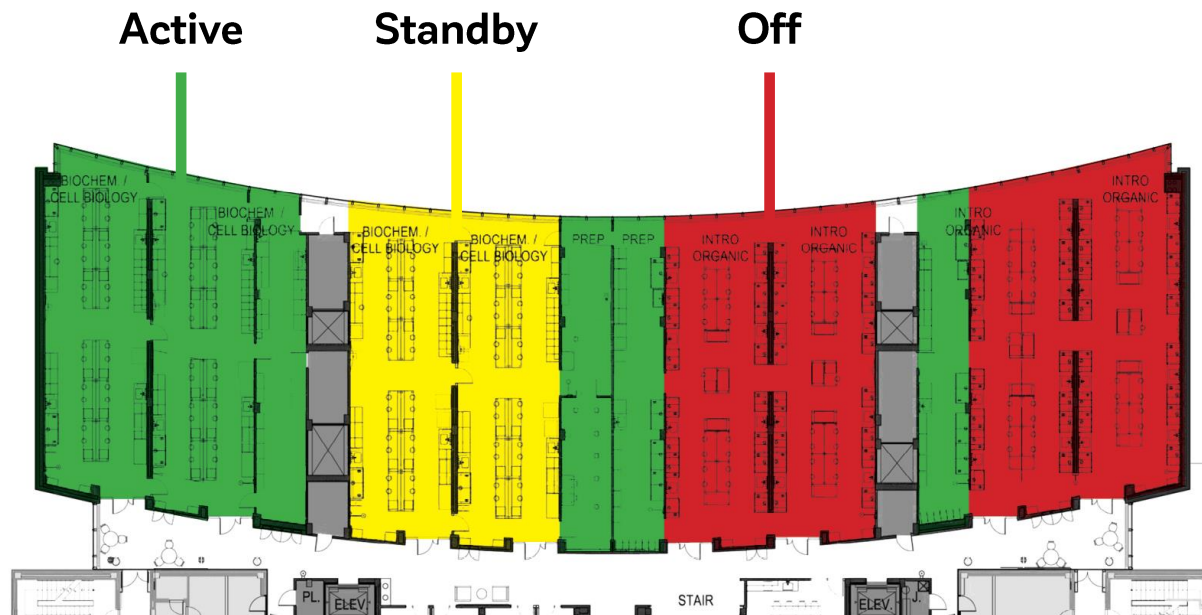
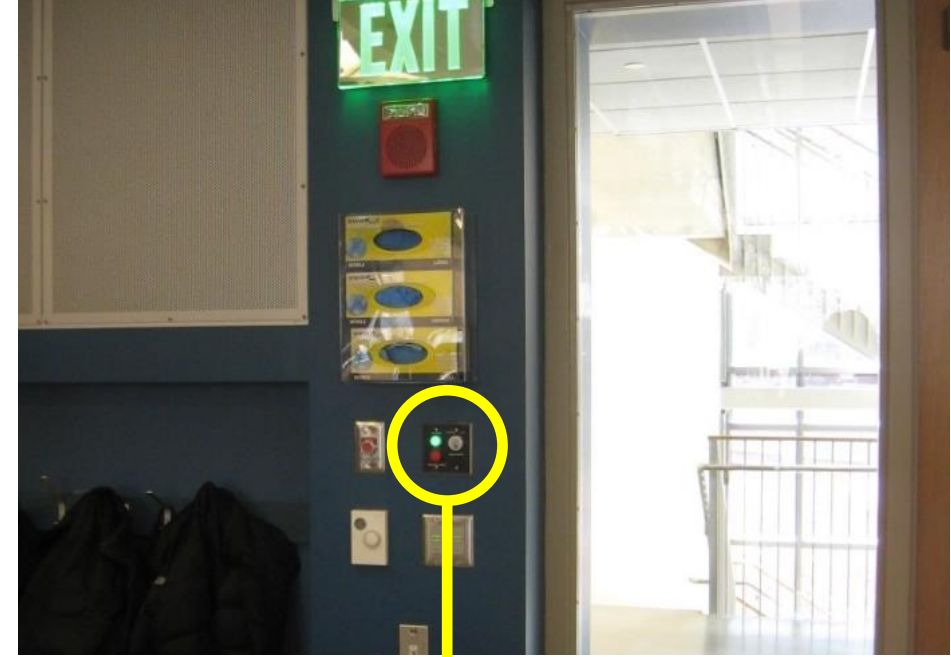
7000CFM



HVAC

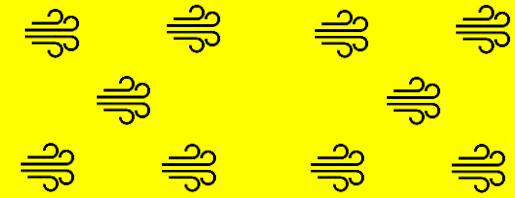
Design for Variability and Turn Off Systems

Ventilation systems (Air) are Responsible for More than 50% of a Lab's Energy





Sizing Methodology



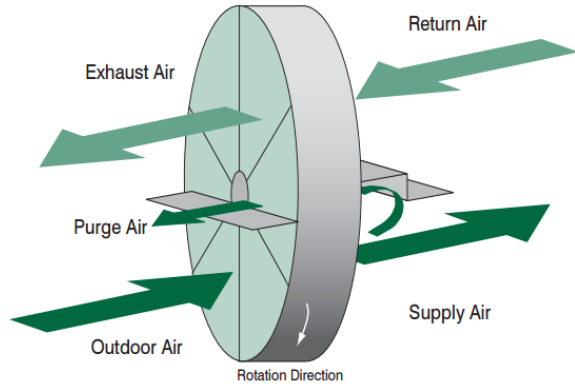
Peak Air Demand
is 100,000 CFM

~~3 AHUs @ 50,000 CFM~~

3 AHUs @ 35,000 CFM

Limited Redundancy Needs
for AHUs, Chillers

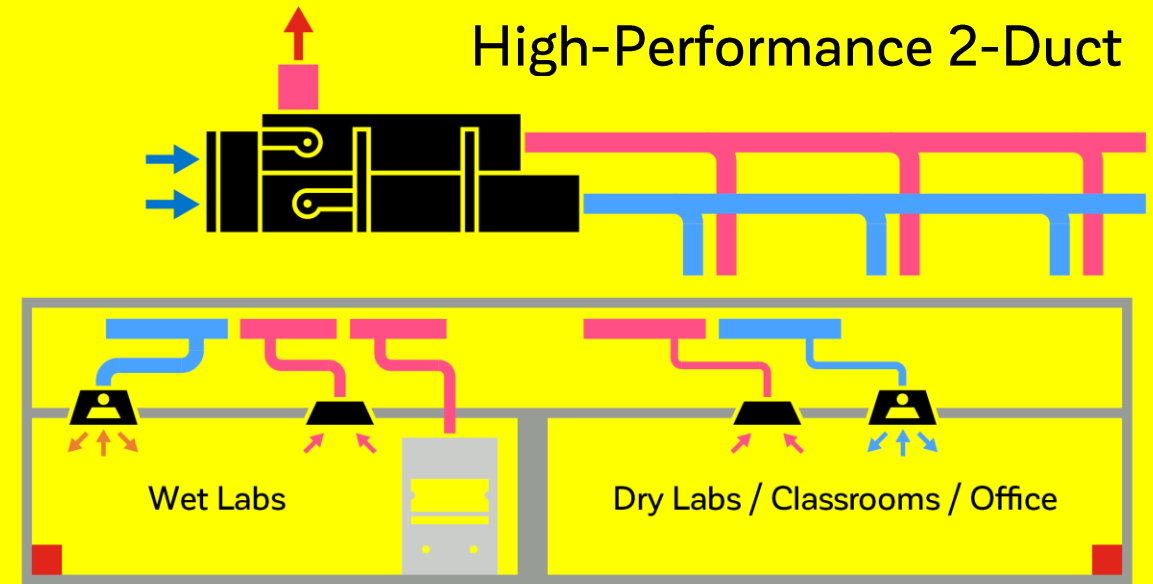
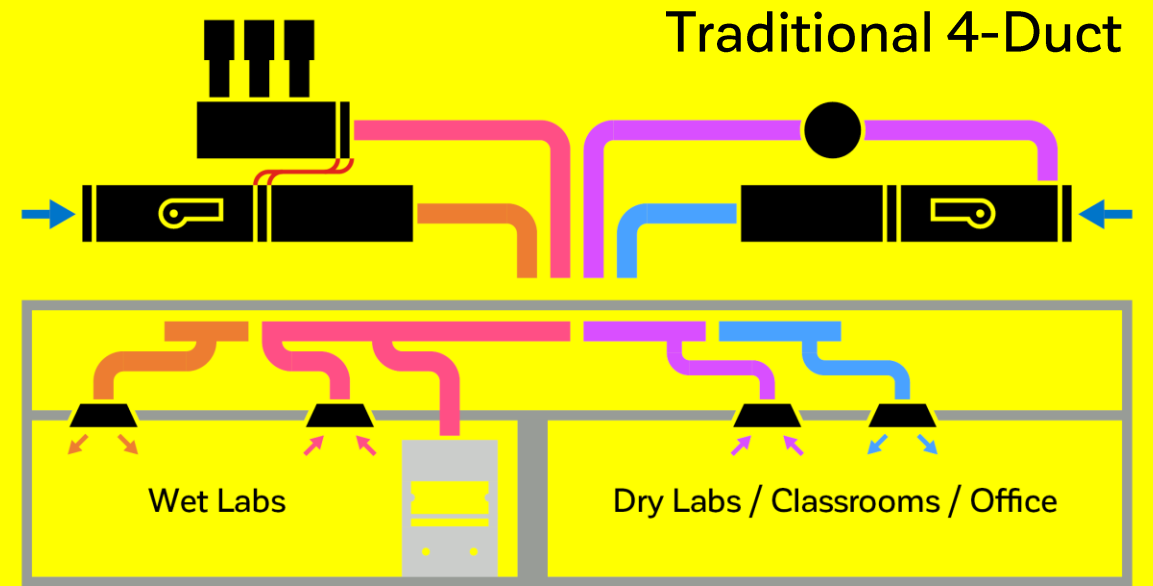
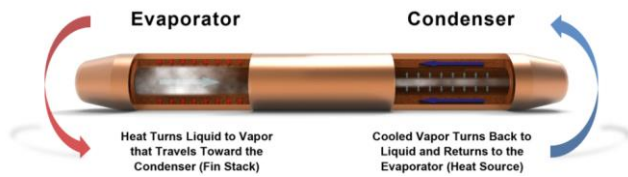
Enthalpy Wheels

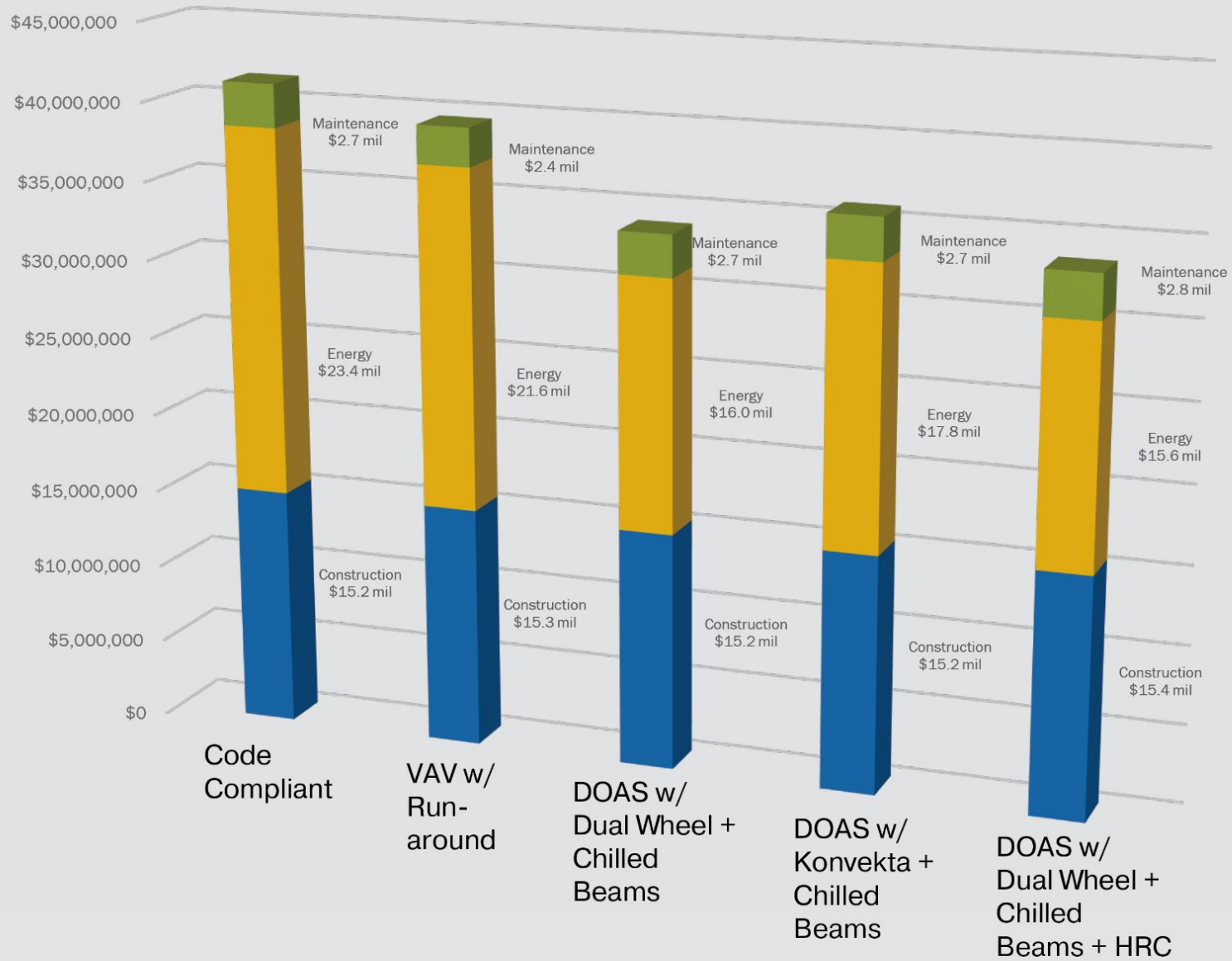


High Performing Run-Around

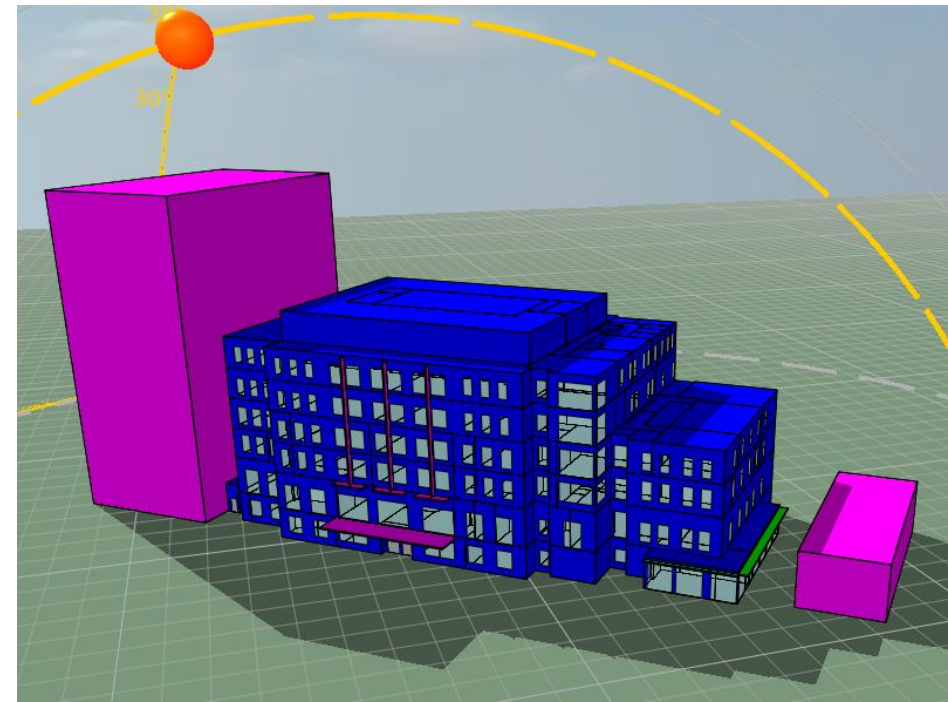


Heat Pipes





Net Cash Flow: 20 year Life Cycle Analysis



Systems Designed to
Inspire Engineering Students

Engineering on Display



FUME HOODS / LAB EQUIPMENT

Over \$500,000 Construction Costs Savings

VCU: Organic Chemistry Has 65 Fume Hoods
@ 14" Sash in Lieu of 18" Saved 10,000 CFM

Fume Hood	Sash closed	100 fpm @ 18" Sash	80 fpm @ 18" Sash	80 fpm @ 14" Sash
Airflow required (CFM)	225	830	670	530



Snorkels – Added Safety for
General Chemistry,
Electronics Laboratories
(Soldering)

Centralized Glasswash
and Sterilization

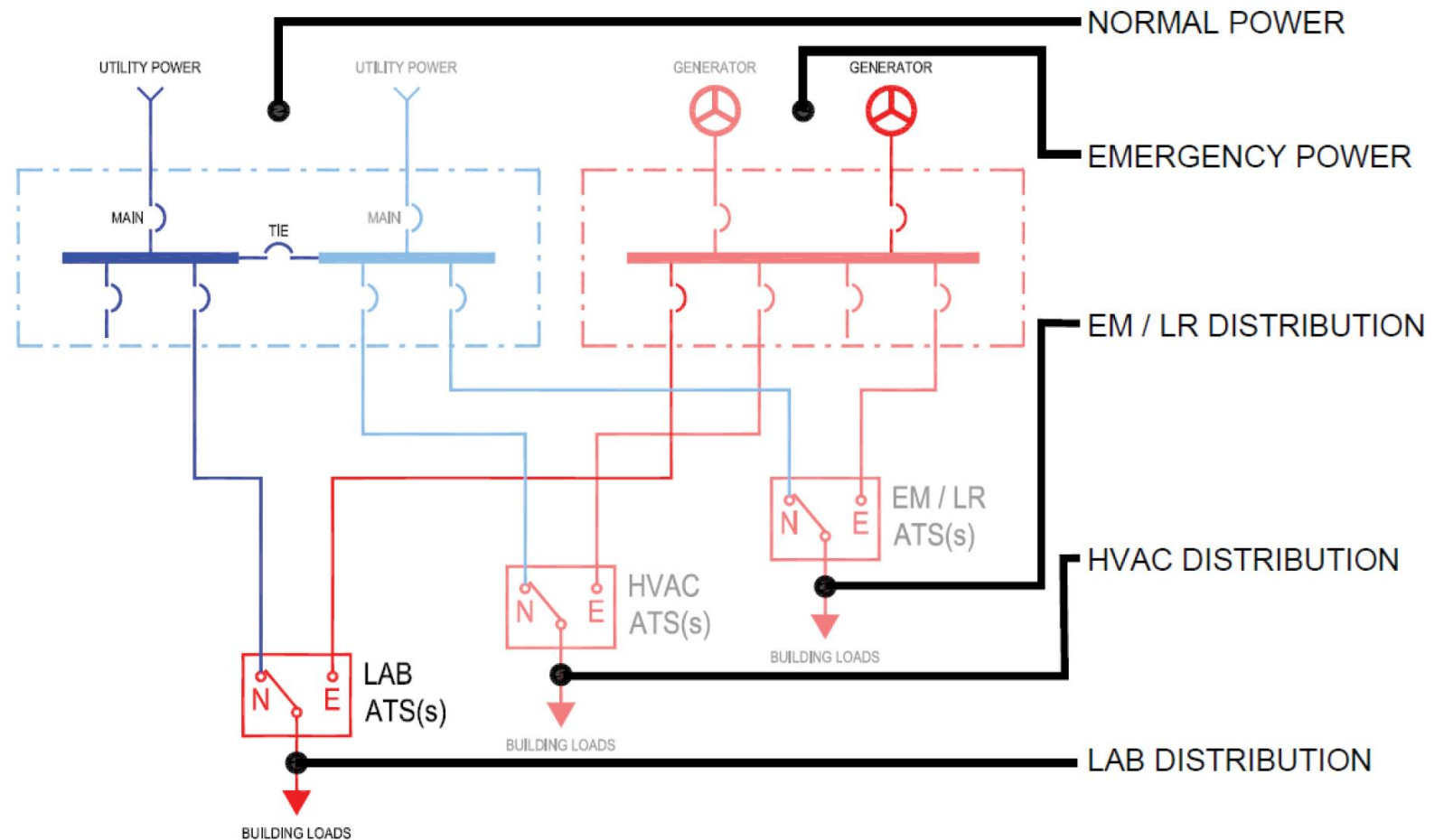


ELECTRIC

Double-Ended Substations Typically Not Required

Single Generator - Limited Epower (Safety Only)

Equipment Load <6 W/sf



PLUMBING

Vacuum: Deep Vacuum
(Rotovaps) & High Variability

Drainage-Piping Material and
Neutralization

Lab and Potable
Water Systems

Eliminate Natural Gas
if Possible



SPECIALTY LABS

Wood Shops & Metal Shops

Capstone / Multipurpose

Student Team Groups

3D Printers & Makers Spaces

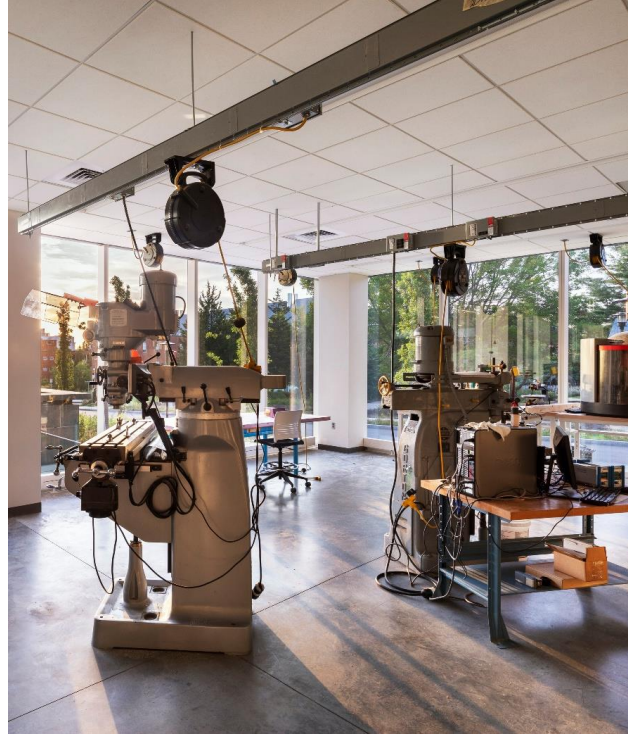
Anatomy Labs

Kinesiology

Nursing / Simulation

Planetarium





Doors and Openings
to Outside

Dedicated Exhausts

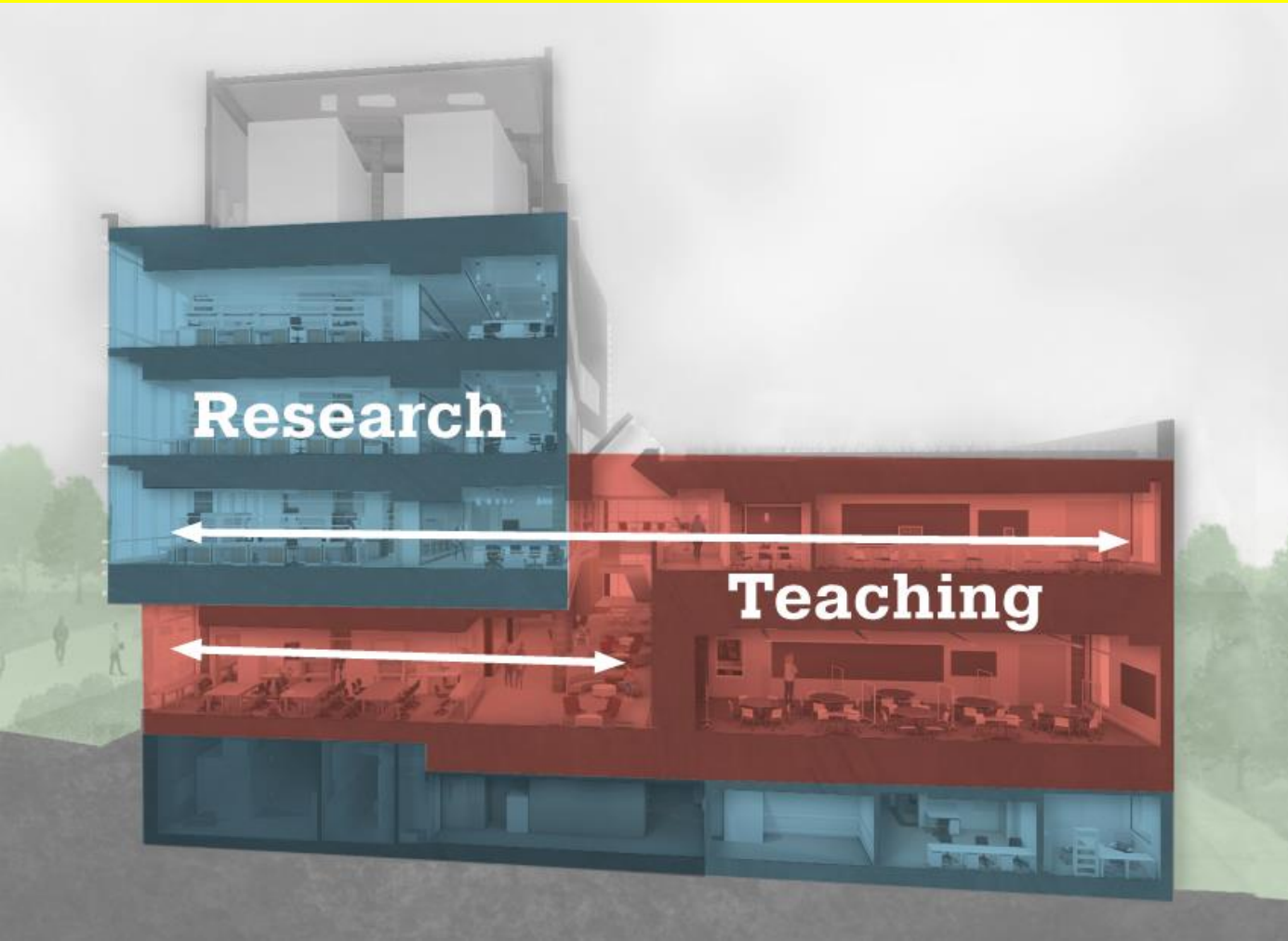
Humidity Control

High Equipment Loads

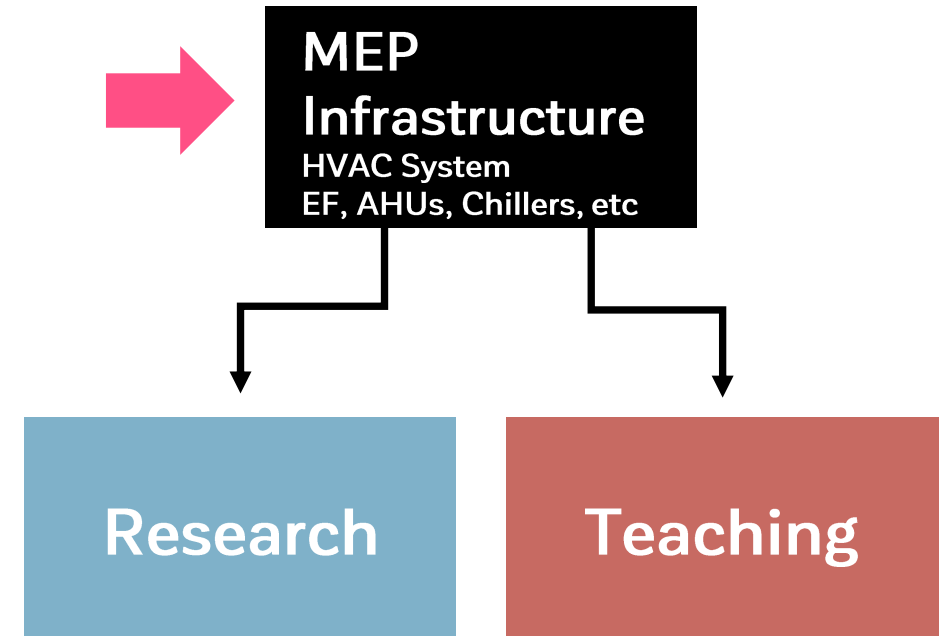


TEACHING & RESEARCH

Hybrid Laboratories



Epower,
Resiliency



Use Controls to Prioritize Research

Variable Teaching Loads Can Benefit
Research Resiliency



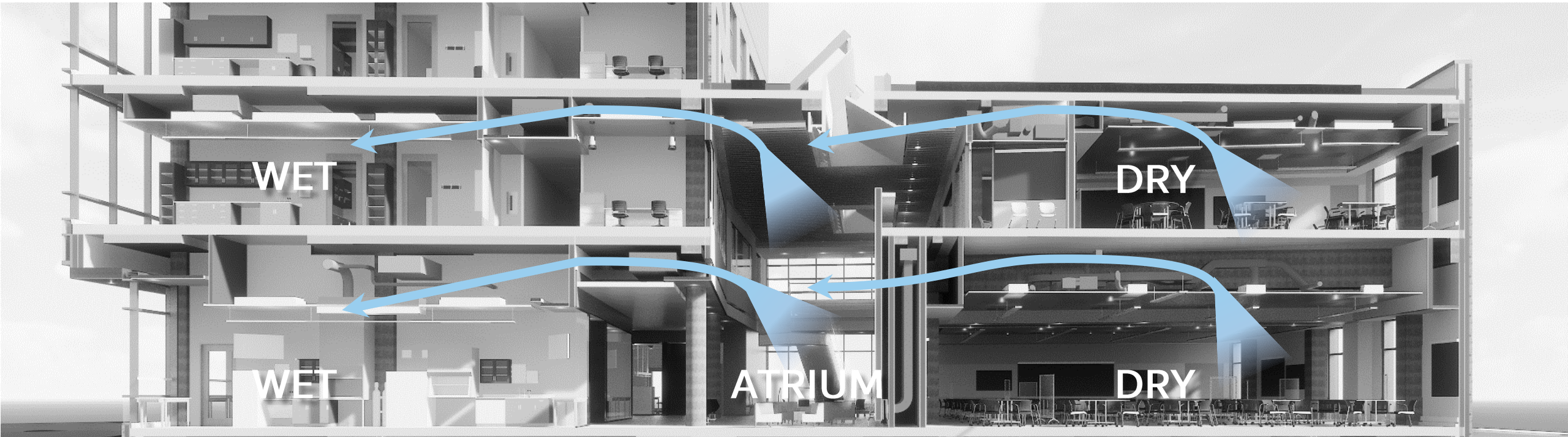
Teaching and Research Labs

Commons

Active Classrooms
450 Students

AIRSHARE

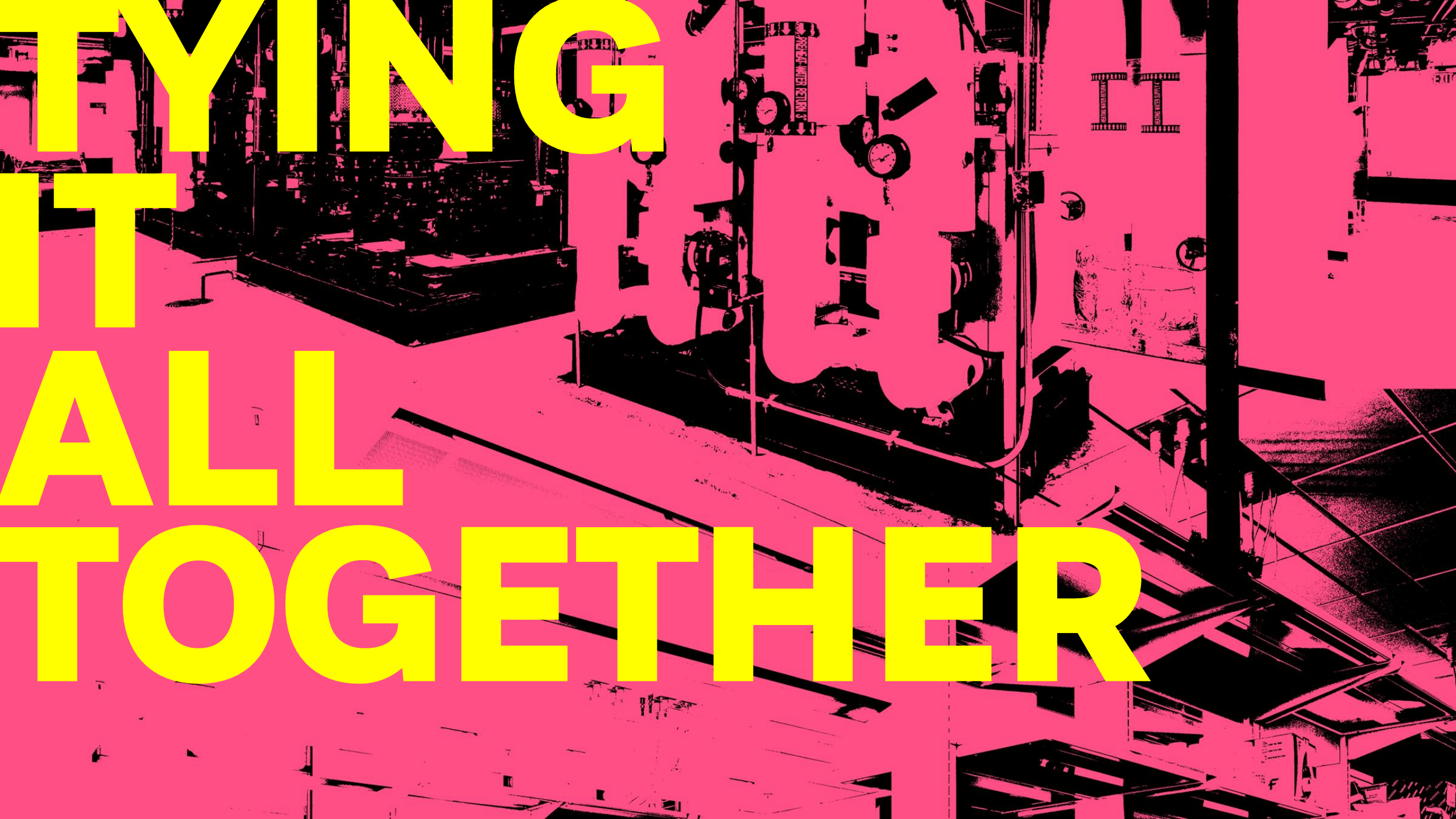
Reusing Air Can Save +10,000



Teaching and Research Labs


Commons

Active Classrooms
450 Students



TRYING
IT
ALL
TOGETHER

TEACHING-ONLY STEM BUILDINGS



Broad Stakeholders: Impacts Institution, Campus,
Program & Research



TEACHING-ONLY STEM BUILDINGS

Broad Stakeholders: Impacts Institution, Campus,
Program & Research

Focus on a Student-Centric Experience
to Improve Outcomes



TEACHING-ONLY STEM BUILDINGS

Broad Stakeholders: Impacts Institution, Campus,
Program & Research

Focus on a Student-Centric Experience
to Improve Outcomes

Have Unique Resilience, Safety,
& Occupancy Requirements



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