

Massachusetts School Building Authority

Steven Grossman
Chairman, State Treasurer

Katherine Craven
Executive Director



MSBA Guidelines for Science Labs

May 26, 2010

www.MassSchoolBuildings.org



Introduction:

Science Lab Task Force

- Participants
 - MSBA Board members and staff, DESE staff, local architects, construction management consultants, science and technology consultants, science educators, science lab safety consultants
- Task Force Goals
 - Obtain feedback from experts and practitioners on recent construction and designs
 - Inform MSBA of optimal science classroom / lab design
 - Make recommendations to update MSBA guidelines



Introduction:

Science Lab Task Force

- Summary Themes
 - Curriculum should drive design
 - Rooms should be flexible to accommodate all science disciplines and reduce the cost of potential future renovations
 - Create Science lab spaces that are designed to support a variety of science functions to optimize overall utilization
 - Safety must be a top priority – overcrowding must be limited



Introduction:

Science Lab Task Force

■ Discussions

- Combination lecture / lab classrooms are the norm
- Fixed demonstration tables
 - limit flexibility and possibility for reconfiguration
 - limit useful space
- Labs should allow students to work safely
 - Students can easily observe teacher in 'lecture mode'
 - Teacher can monitor all students in 'lab mode'
- Fixed perimeter with movable peninsulas provides flexibility
- A stated goal of 85% utilization for general classrooms may not be achievable for science labs
- Research indicates that the ratio of accidents to square foot per student greatly increase when there is less than 60 square feet per student, or more than 24 students per classroom*

* Motz, Biehle and West, The NSTA Guide to Planning School Science Facilities, 2nd Edition, National Science Teachers Association 2007, <http://www.nts.org>



Introduction:

Science Lab Task Force

- Recommended Regulation Changes
 - High school space requirements updated Jan 2010:
 - Minimum lab / classroom size updated from 1,200 nsf to 1,440 nsf (60 nsf x 24 students)
 - Science prep rooms increase from 80 nsf to 200 nsf per lab (shared prep rooms, if possible, are preferable)
 - Central chemical storage of 200 nsf added
 - Provide fixed casework around the perimeter only, projecting peninsula / island work stations should be moveable. All utilities should be in the perimeter



Introduction:

Science Lab Task Force

- **Recommended Regulation Changes** (continued)
 - Show small tables with stools in the lecture part of the labs, not chairs with fixed tablets. Tables should match height and finish of perimeter counters
 - The teacher's demonstration station should be moveable, not fixed to the floor
 - All science labs should be provided with water and gas systems, not just the "wet" labs. (stub systems as required for potential future use)
 - Every science lab should be capable of both "lecture & lab" arrangement



Introduction:

Science Lab Task Force

Fixed Demonstration Table

“Restricted” area

217 nsf (15% of room)

Room Size: 1,475 SF

24 Students / 1 Instructor

25 SF /student 1n Lab Area

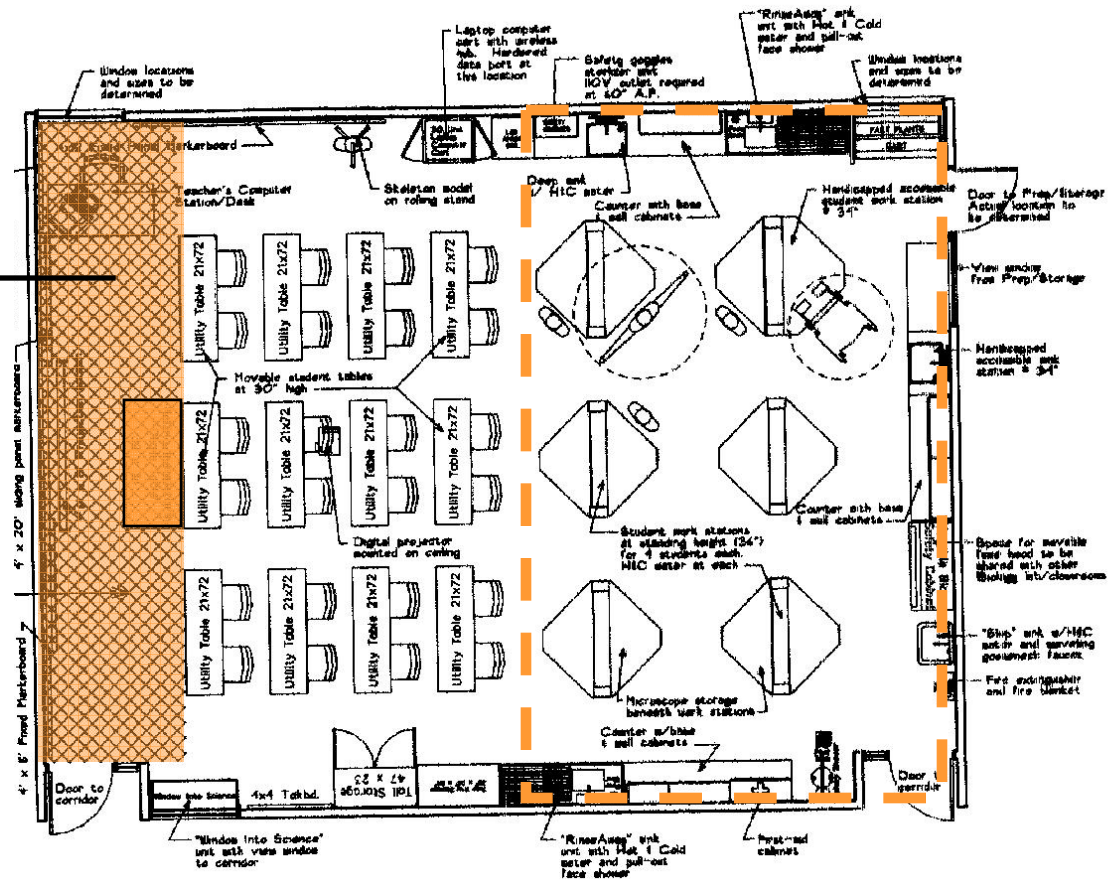


Image provided by James T. Biehle
Inside Out Architecture



Introduction:

Science Lab Task Force

Typical Lecture / Lab Configuration

Classroom Area

Lab Area

Room Size: 1,470 SF
 24 Students / 1 Instructor
 30 SF / student in Lab Area

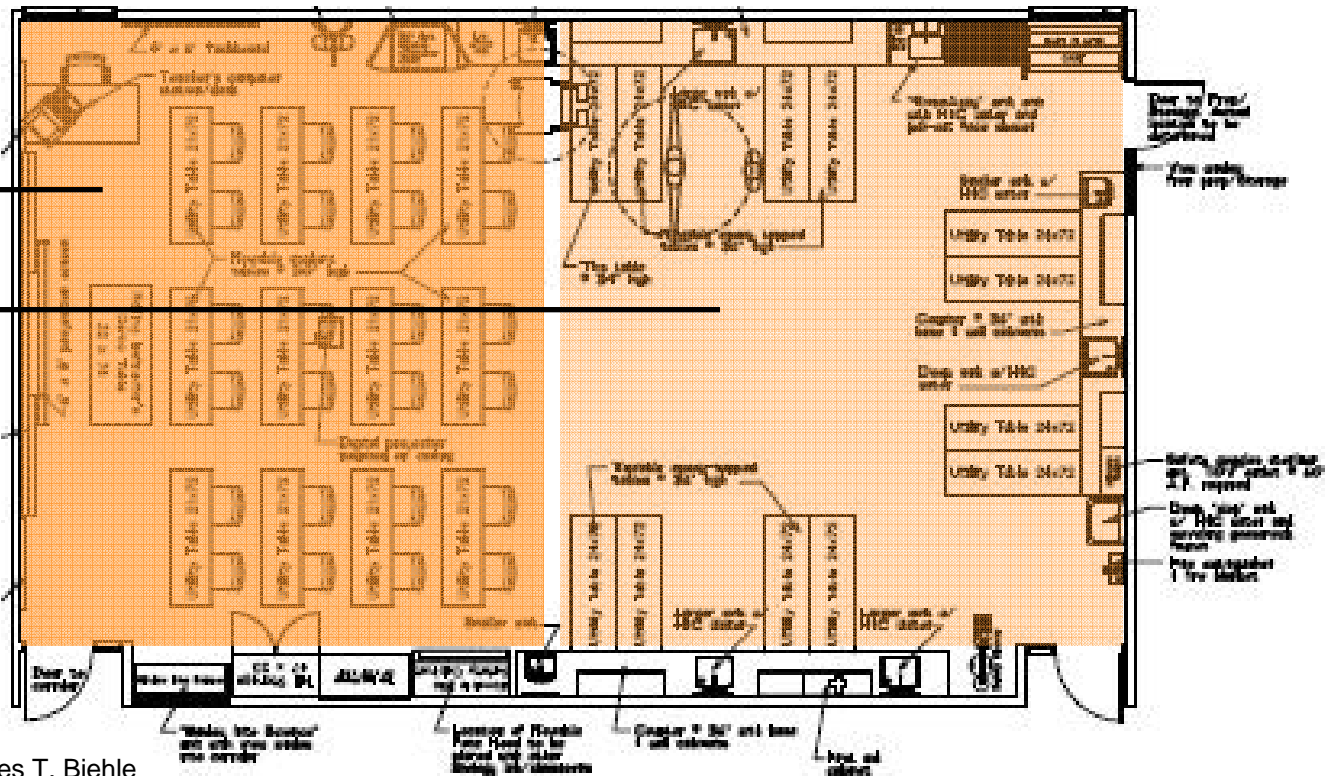


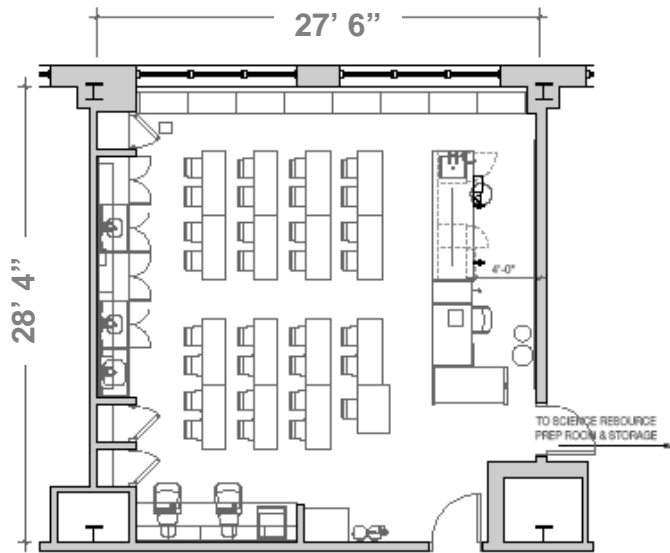
Image provided by James T. Biehle
 Inside Out Architecture



Prototype Design

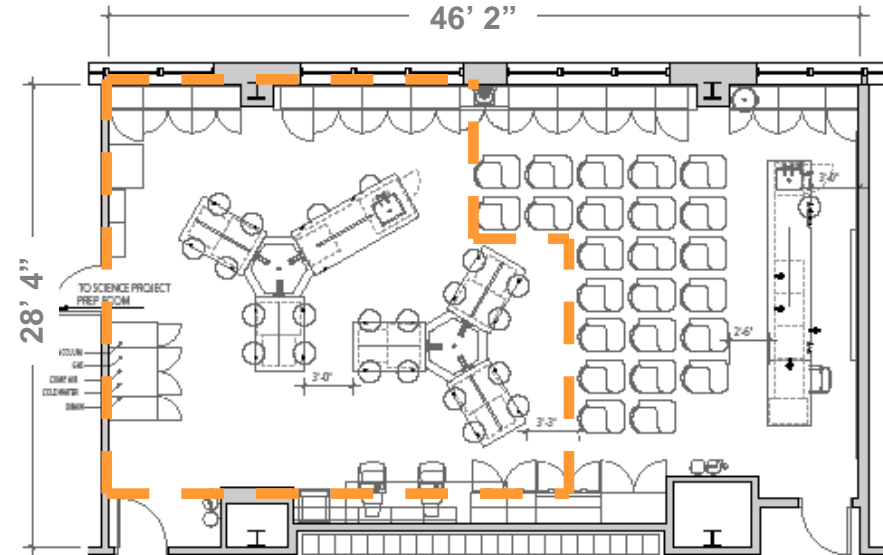
■ New York School Construction Authority

<http://www.nyc.gov/html/sca/home.html>



SCIENCE / DEMO ROOM W/ WORK STATIONS FLOOR PLAN

Room Size: 779 SF
31 Students / 1 Instructor



TRIFACIAL LABORATORY FLOOR PLAN

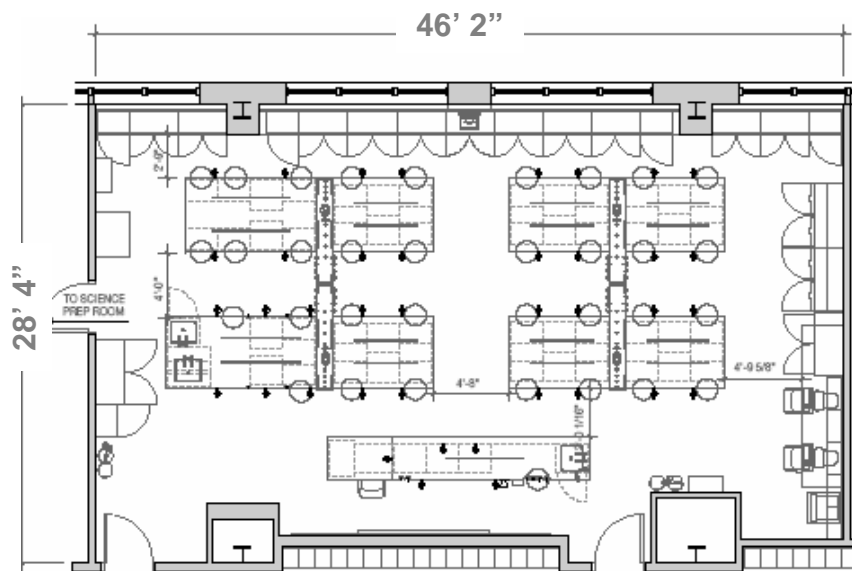
Room Size: 1,307 SF
24 Students / 1 Instructor
27 SF /student in Lab Area



Prototype Design

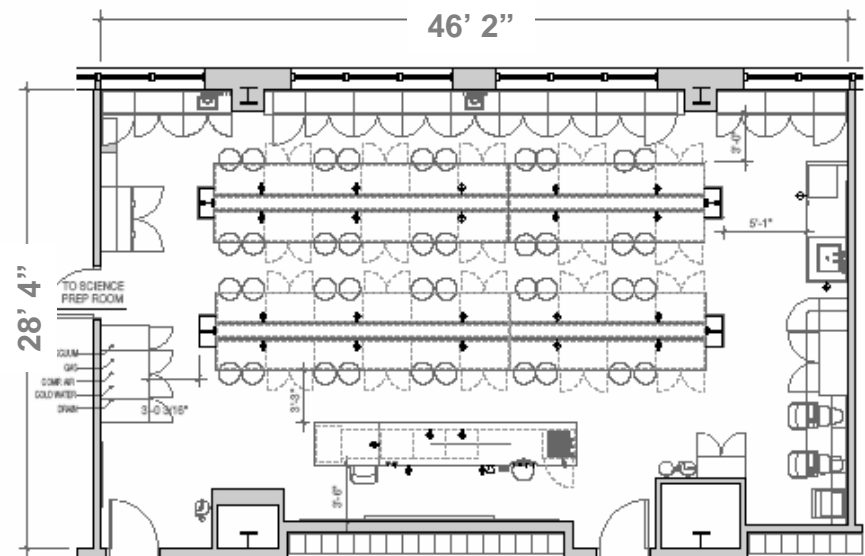
■ New York School Construction Authority

<http://www.nyc.gov/html/sca/home.html>



STANDARD PHYSICS LAB FLOOR PLAN

Room Size: 1,307 SF
34 Students / 1 Instructor
38 SF /student in Lab Area



STANDARD CHEMISTRY FLOOR PLAN

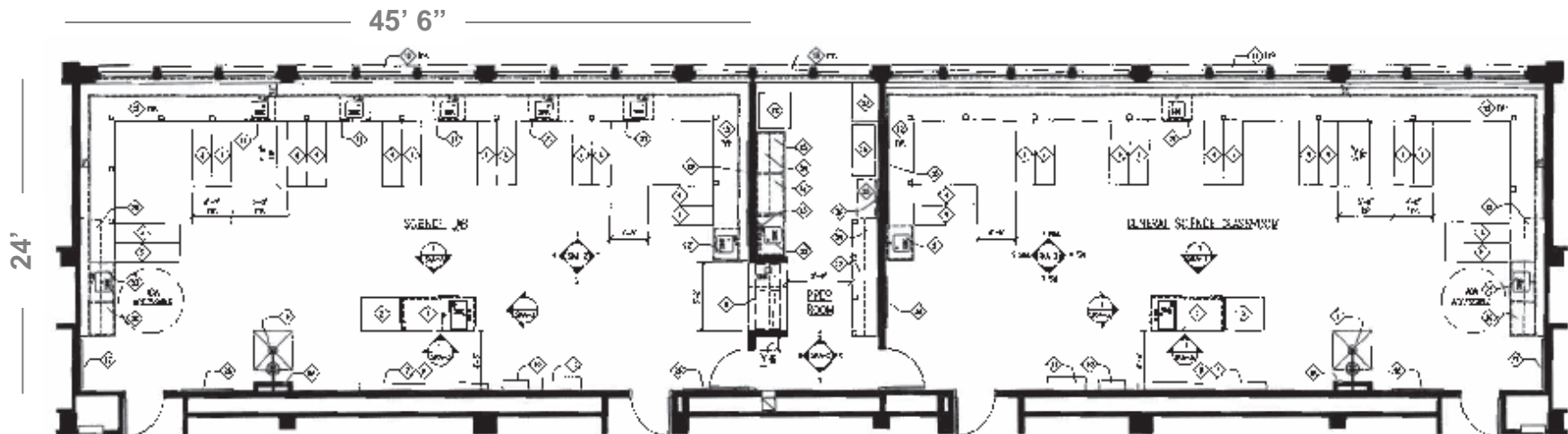
Room Size: 1,307 SF
40 Students / 1 Instructor
32 SF /student in Lab Area



Prototype Design

Chicago Public Schools

<http://www.cps.edu> – Chicago Public Schools – Capital Improvement Program – Science classroom design guide



- Perimeter counters are provided without base cabinets underneath
- The labs are smaller than MSBA (1,100 sf) and have more students (28 + one teacher, 39 SF per student)
- The Teachers demonstration table is fixed
- The student tables have adjustable height metal legs
- 3 “Treatment Levels” provide one fume hood per school, and gas in 25% of the labs. The remaining 75% of the labs get 3 sinks each

Level	Gas Distribution	Fume Hood	Student Work Sinks	No. of Spaces Required at a High School
1	Yes	Yes	7	1 Instructional Space
2	Yes	No	7	25% of Total Spaces
3	No	No	3	All Remaining Spaces



Conclusion:

MSBA Prototype Design

■ Notes

- The following diagrams are examples of table arrangements that can accommodate a wide variety of activities, groupings, and instructional configurations that are typical of laboratory work and instruction in small, medium, and whole-class groups. The intent is to design spaces with maximum flexibility for varied uses without extensive reconstruction.
- The following plans are to be considered standard template configurations; specific school designs may vary from these standards.
- The items described as "requirements" are mandatory, other items are MSBA recommendations are to be considered "best practices."



Conclusion:

MSBA Prototype Design

■ Requirements

- The MSBA allotment of 1,440 nsf for each science lab is based on 60 nsf per student (24 students). Smaller science classrooms may be considered if the class size is smaller, with a minimum of 60 nsf per student.
- The district and design team should provide for a science lab layout that allows as much flexibility and universality as practical, given the districts science department educational plan.
- Both lab and lecture configurations must be accommodated in every designated science lab room. Separate labs and lecture rooms are not permitted.
- No raised lab utilities, that may restrict flexibility, are to be provided in the central floor area of the science labs. Utilities from a grid suspended from the ceiling may be needed for some disciplines, but only if the peripheral utilities cannot accommodate most needs.
- No fixed casework is permitted in the central floor area.



Conclusion:

MSBA Prototype Design

■ Best Practices

- Sturdy, standing-height two-student tables should match the height of peripheral countertops so that students perform lab work standing (preferable) and "seat work" on stools. Two-student tables (not larger) are recommended so they can be moved into a variety of configurations. Adjustable-height tables are not recommended.
- Stub utilities where needed for potential future configurations.
- Sinks should be wide and deep enough to accommodate buckets and other large containers.
- Optional fume hoods and bio-safety cabinets should be accessible from both the prep room and the classroom.
- Provide full black-out window treatment in labs.
- Provide moveable teacher demonstration tables. (not fixed)
- Each lab prep room should include one refrigerator and one dishwasher.



Conclusion:

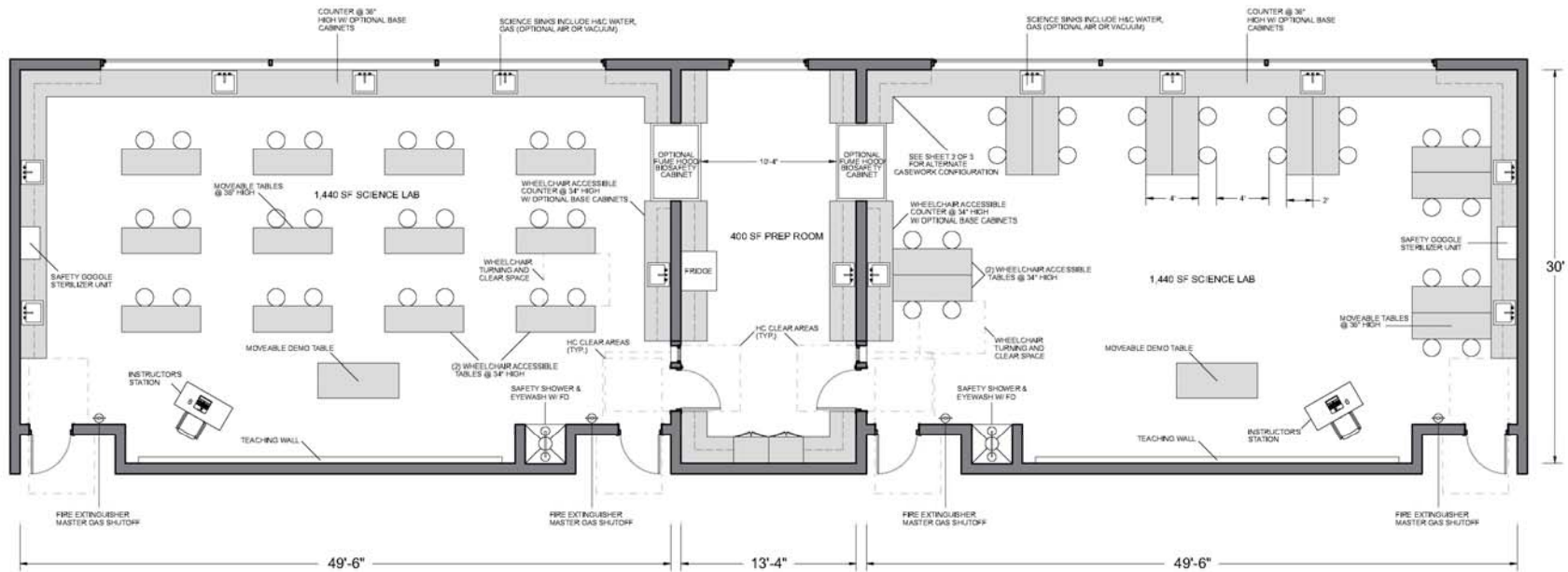
MSBA Prototype Design

- **Best Practices (continued)**
 - Provide visual access between labs and prep rooms / prep room doors.
 - Shared spaces can be reduced in area, with saved areas reallocated elsewhere as needed.
 - Prep rooms and chemical storage should be keyed in such a way to provide limited access, for required personnel only.
 - At the districts discretion, chemical storage can be divided into satellite storage rooms, but chemical storage in prep rooms is discouraged.
 - Safety equipment and information such as fire blankets, sterile eye-protection, and material safety data sheets (MSDS) should be located in highly-visible and easily-accessed places, preferably near exits and other required safety equipment.
 - Rather than green houses, consider designs that allow plants to be placed on shelves or moveable racks with access to light from classroom windows.
 - At least two means of egress from each lab should be provided (the building code may require this, depending on area).



Conclusion: Prototype Design

■ Scheme A



Front Facing / Large Group Instruction /
Teams of 2 Configuration

Room Size: 1,440 SF
24 Students / 1 Instructor
60 SF /student in Lab Area

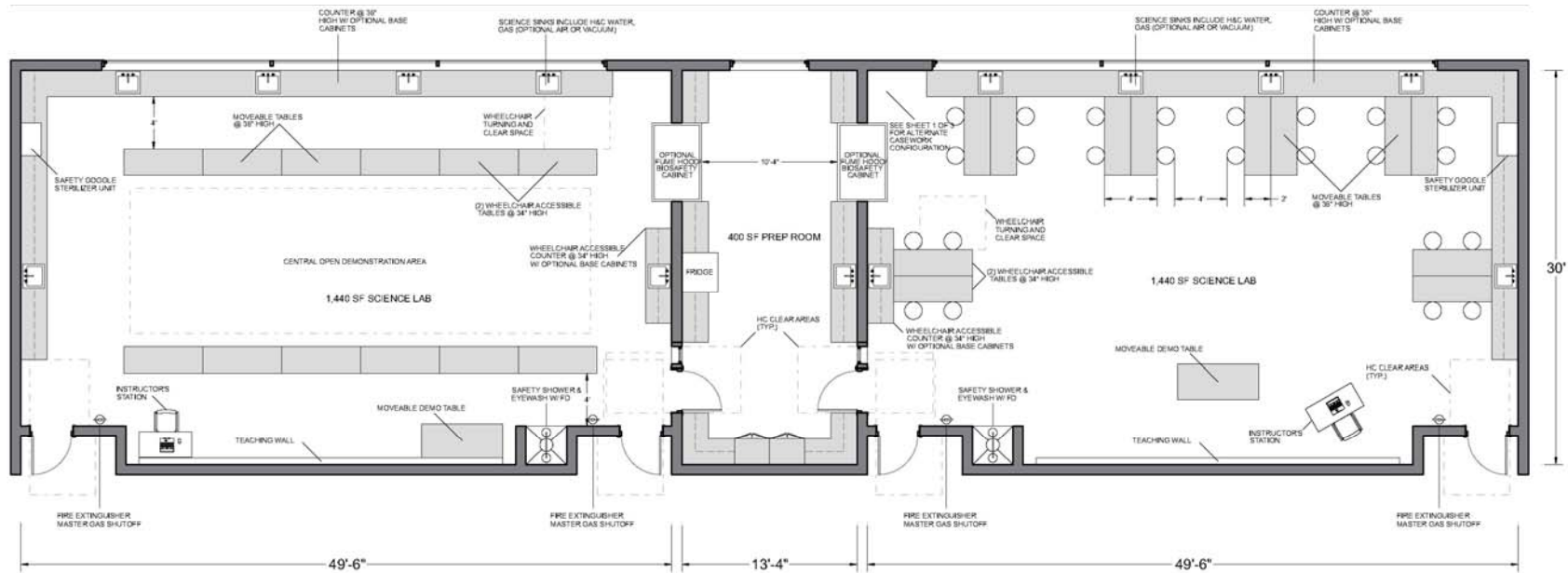
Lab Configuration 1

Room Size: 1,440 SF
24 Students / 1 Instructor
60 SF /student in Lab Area



Conclusion: Prototype Design

■ Scheme B



Ramp / Motion Studies Configuration

Lab Configuration 2

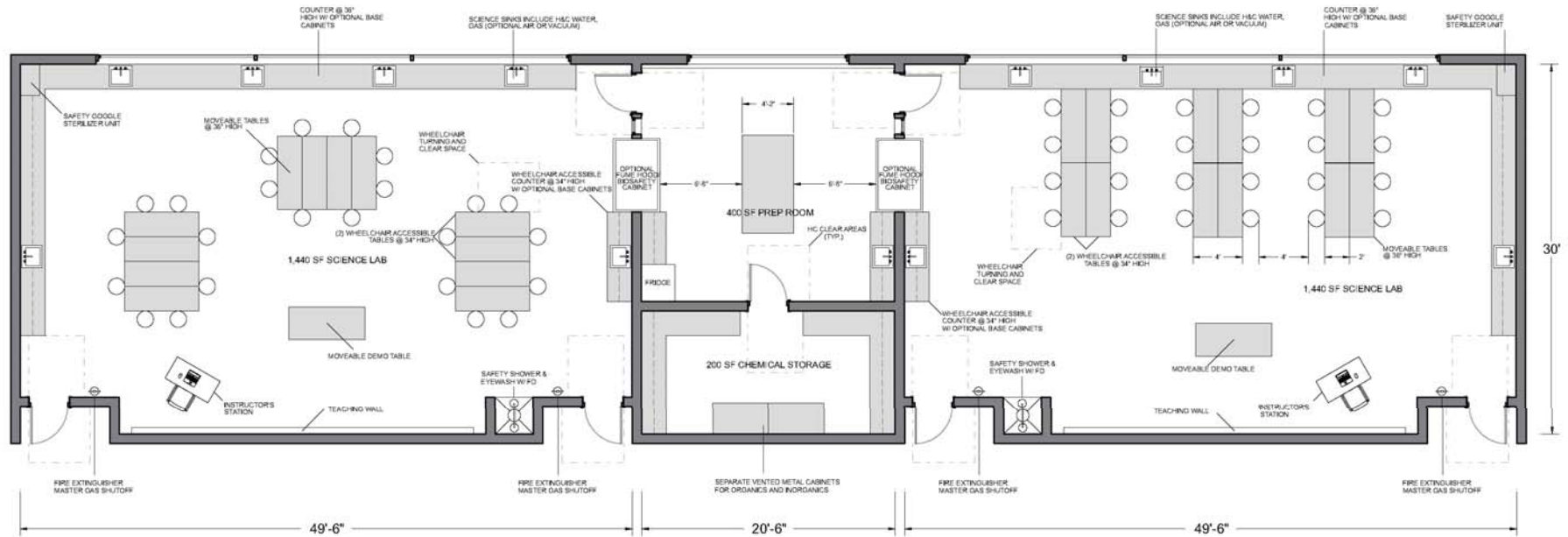
Room Size: 1,440 SF
24 Students / 1 Instructor
60 SF /student in Lab Area

Room Size: 1,440 SF
24 Students / 1 Instructor
60 SF /student in Lab Area



Conclusion: Prototype Design

■ Scheme C (showing chemical storage room)



Mid-size group / Robotics Configuration 1

Mid-size group / Robotics Configuration 2

Room Size: 1,440 SF
24 Students / 1 Instructor
60 SF /student in Lab Area

Room Size: 1,440 SF
24 Students / 1 Instructor
60 SF /student in Lab Area



Conclusion: Prototype Design

■ Egress Calculation

1,258 NSF -----
Movable Tables

1,097 NSF —————
Fixed Demo Table and Peninsula

Table 1004.1.1 educational occupancy (classrooms) assumes 20 SF of net floor area per occupant (that goes up to 50 SF per occupant for shops and other voc tech rooms).*

Table 1015.1 educational occupancy max load of 49 occupants for rooms with one means of egress.*

Therefore 2 means of egress is required for any classroom with greater than 980 SF of net area (exclusive of built-in casework, fixed equipment, etc).

* 8th Edition Massachusetts State Building Code

