

Chemistry Laboratory Design

Forty-five Ideas, Tips, and Hints to Help You Design a Safe and Efficient Chemistry Laboratory

The overall safety profile of your school would be greatly improved if the chemistry laboratory, preparation room and chemical stores area were properly designed in the first place. Many schools are now in the process of renovating or building new chemistry labs. As the chemistry teacher who will work in these labs, you want them properly designed. Where are you to learn about chemistry lab designs that work? Who knows which designs are best for your specific laboratory needs? The answer is simple—Flinn Scientific!

Typically a local architect is hired to design a new school or science lab. It's assumed that the architect will ask the right questions and will have all the correct answers. Unfortunately, the architect may have little or no experience designing a chemistry lab. Are architects up-to-date on the specific needs of today's chemistry teacher and the laboratories they work in? Do they understand what is required to design a science lab in the 21st century? Do architects understand the need to have great laboratory ventilation, a separate room where you can safely store laboratory chemicals, ample preparation area, and ample space at student lab stations so overcrowded conditions won't cause accidents?

We've developed a list of requirements we think make for an efficient and safe chemistry laboratory. This list is by no means complete, but it will give you a good start. Please remember that many of your design questions and concerns can be solved by calling Flinn Scientific. Our staff is ready to help answer your questions. Call us toll-free at 1-800-452-1261.

Chemistry Laboratory

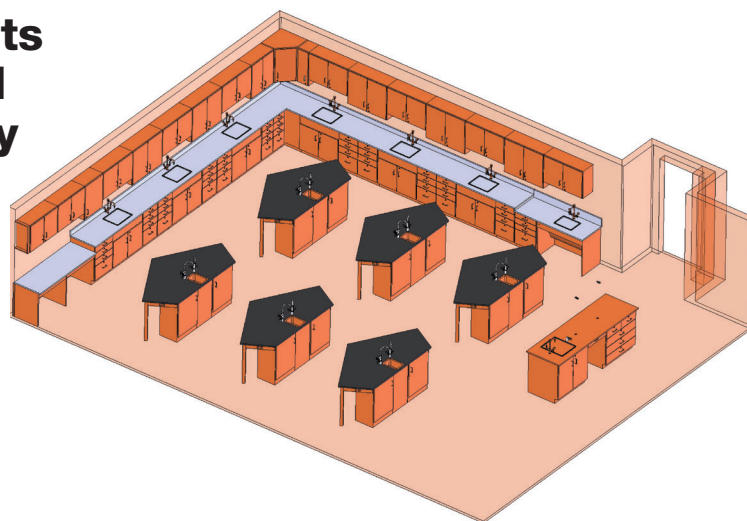
1. Will the laboratory have a fume hood? Will the fume hood have gas, electricity, water, and a sink? Where will the fume hood be located in the laboratory? A good rule of thumb is to keep the fume hood location away from heavy student traffic areas and main exits.
2. Table tops should be black epoxy resin.

3. Floors should be vinyl tile. Properly installed they are easily cleaned and relatively chemical resistant. Consider using non-skid wax. Carpet should never be used in a chemistry laboratory!
4. A handicap access lab station should be provided in at least one chemistry lab.
5. Ventilation in the chemistry lab is a must. Each laboratory must have its own ventilation purge fan which removes at least 3200 cubic feet of air per minute. These fans should be vented directly to the out-of-doors and should not be interconnected between rooms. An on/off switch should be provided allowing the instructor to turn the fan on and off depending on the types of activities being conducted. The fans are not intended to be run all day long, but on an as-needed basis.

Your ultimate goal with a purge fan is to have a complete room air change in five minutes. Positioning of the fan will depend on your laboratory design. Remember fume hoods are not designed for general lab ventilation!

6. Make sure you have plenty of electrical outlets with ground fault interruption.
7. Will computer cables be run to each lab station for future use of computers?
8. Knowing that these labs are being built to last 30 or more years, should the lab be designed to include some common features so biology and physics may be taught there?

9. A fire blanket, fire extinguisher (ABC type), eyewash, and a shower or body drench (with drain) should be placed in labs where hazardous chemicals will be used. Depending on where the teacher's demonstration table is located in relationship to the general lab area, you may need two eyewashes, fire blankets and fire extinguishers.
10. Will you have a demonstration table? Will it have water, electricity, gas and a sink? A large sink is always nice to have in a demonstration table.
11. Master utility cut-off valves for gas and electricity are essential. Make sure they can be accessed easily in case of emergency.
12. Where will goggles be stored? Where will students hang or store their aprons?
13. Look at furniture designs which maximize student spacing at each lab station.
14. Good sight lines are critical for a chemistry teacher. Can you see most of the lab activity from one vantage point? Can you move easily from one lab station to another without going around student desks and chairs? Your ability to supervise students' lab activity must not be compromised.
15. Do you have ample storage for apparatus, hardware, equipment, etc.?
16. Are sinks a usable size? Do you want hot and cold water at each lab station?
17. All safety equipment must be marked with location placards/signs.
18. Do you need non-reactive waste receptacles? Fireproof trash cans?



Chemistry Laboratory Design, continued

19. Where will spill control materials be stored in the lab?
20. Do you want laboratory stools? For safety and space issues, stools are not used in many labs.
21. Do you want dry erase or chalkboards in the lab? Where do you want them located?
22. Does your state require two exits? If so, where will they be located?
23. Will the laboratory have ample lighting? 75 to 100 foot-candles is suggested at bench level.
24. Do exit doors have sturdy locks and self-closing return hardware?
25. Contact the five major laboratory furniture companies listed below. They are all fine companies and will provide free assistance in designing your labs. Their catalogs are valuable resources and provide lots of ideas. Make good use of these free resources.
26. Will the prep area have gas, electricity, water and a sink?
27. The prep area should have a fire blanket, eyewash, fire extinguisher and possibly a body drench or shower.
28. Spill control materials should be located close to your main preparation area.
29. The prep/storage area should have a vinyl tile or concrete floor, double drywall ceiling and walls. The door should have self-return hardware with an automatic lock and a fire rated door. The door should swing out if it is your only exit. You don't want the door to be blocked from opening if an "event" were to occur in this area. Signs on the door should say "Authorized Personnel Only".
30. A stepladder should be provided to help retrieve items from the top shelves.
31. Will your prep area have a water still or water demineralizing system? If so, where will it be located?
32. Consider installing drying racks for glassware above the sink.
33. A good preparation area is just like your kitchen at home. You want plenty of counter and storage space.
34. Will a telephone or intercom system be available in case of emergency? You need a method to contact outside help.
35. There should be emergency lighting in the prep/chemical storage area should the power go out. If your labs do not have windows, emergency lighting should also be provided in the lab area.
36. Have smoke detectors installed in the chemical stores area and in an adjacent hallway. Both units should be line operated and go off together should fire/smoke develop in this area. This smoke alarm system will alert others in the school that a problem has developed.
37. Some architects are now installing acid dilution basins in chemistry labs. These can create a potential problem. Dilution basins should be checked, cleaned and recharged every six months to a year. If not, they could turn into a "chemical dump" or "hazardous waste site" and cause costly problems, i.e., OSHA fines, cleanup costs, etc. Does your state's law require an acid dilution basin be put in the chemistry lab?
38. Will the prep area have a first aid kit?
39. Do you use laboratory carts? If so, the prep area should have an area where the carts can be stored when not in use.
40. Consider building a separate chemical stores area next to the preparation area. Contained and secured chemical storage solves lots of problems.
41. Approved flammable liquid and acid storage cabinets should be in the chemical stores area.
42. Shelves in the chemical stores area should be firmly secured to the walls. Shelves should have a lip on the front to prevent bottles from rolling off the shelves.
43. Chemicals should not be stored more than six feet above the floor.
44. The chemical storage door should be a solid-core, fire-rated door (preferably hinged out). Door should have a good lock and be labeled to identify hazardous contents to alert and protect firefighters. Interior walls and ceiling should be double drywall to make this a fire rated room.
45. Chemical storeroom ventilation is a must. Four air changes per hour is a minimum. Air should be "pulled" from floor level and be exhausted directly to the outdoors.

The proper design of a chemistry lab can be very time-consuming. Acquaint yourself with as many ideas as possible and decide which ideas best fit your needs. Consider visiting other schools to look at their chemistry labs. What do other chemistry teachers like or dislike about their labs?

Contact the five major laboratory furniture companies discussed in this article. Their resources and ideas are invaluable.

Finally, depend on Flinn Scientific for suggestions, advice and help. We know what it takes to design a new chemistry lab and will be more than happy to help you.

Laboratory Furniture Companies You Should Contact When Designing a Chemistry Laboratory

The list of laboratory furniture companies shown below is not exhaustive. All of the companies listed are large manufacturers offering complete lines of laboratory furnishings and have sales representation in almost every state. While the companies listed are all fine companies, this list should not be considered as a recommendation by Flinn Scientific, Inc.

Diversified Woodcrafts, Inc.

P.O. Box 160, Suring, WI 54174-0160 • (920) 842-2136 • www.diversifiedinc.com

Kewaunee Scientific Equipment Corporation

P.O. Box 1842, Statesville, NC 28687 • (704) 873-7202 • www.kewaunee.com

Leonard Peterson

P.O. Box 2277, Auburn, AL 36831-2277 • (334) 821-6832 • www.lpco.com

CampbellRhea Institutional Casework Inc.

1865 N. Market Street, Paris, TN 38242 • (731) 642-4251 • www.campbellrhea.com

Sheldon Division, General Equipment Manufacturers

P.O. Box 836, Crystal Springs, MS 39059 • (601) 892-2731 • www.sheldonlabs.com

Lab Design Priority Lists



Setting priorities helps keep everyone involved in the design process focused on what the important features of the laboratory are. Priorities especially give direction to the architect, lab furniture company, or anyone else who may be assisting in the design process. Priorities also help in making tough budget decisions. Setting priorities is an absolute must for any lab design process.

Here is a list of priorities Flinn Scientific has developed for the chemistry laboratory, chemistry prep area, chemical storage area, biology laboratory and biology prep area. These lists are by no means complete, but will certainly help you in getting a priority list started. Please remember, a priority list is a “living” list. As you visit more labs and are exposed to more ideas, your priorities will change and become more focused over time.

Chemistry Rooms

1. Lab ventilation. Air for lab ventilation shall directly flow into the laboratory from non-laboratory areas and out to the exterior of the building, away from ventilation intake ports. The ventilation fan must remove the air a minimum of eight air changes per hour or 3,200 cubic feet per minute (cfm).
2. Minimum size of 1,400 square feet for the chemistry lab/lecture area with a maximum of 24 students.
3. Lab workstations arranged so a maximum of working students can be observed directly. Four students (two teams of two) will be working at each lab station. Whatever furniture arrangement used must provide maximum visibility, optimum supervision, optimum student/teacher contact, and optimum cooperative learning among students. Are book storage bins in lab stations or locking cabinets needed?
4. Ample space between lab stations. Preference is for students not to be working directly back to back.
5. Eye/face wash, safety shower, fire blanket, fire extinguisher, and spill control materials strategically located. Floor drain for the shower is required.
6. Large sinks are a must, one for each lab station. Are both hot and cold water needed? Size should be a minimum of 16" x 20". Gas will be at each lab station.
7. Fume hoods. Two per room. 48" long. Vented directly to the exterior of the building. Recommend Flinn SE9000 with SE9003 base cabinet. Hood should have water, gas, and electric connections.
8. Ample general storage is a must.
9. Student storage is required.
10. Electricity to support hot plates, etc. Need two sets of two duplex outlets with GFI protection for each lab station.
11. Work surfaces should be black epoxy resin.
12. Demonstration desk with gas, hot/cold water, and ample electricity.
13. Main gas shut-off in each lab area.
14. Chalk or marker board, 20–24 linear feet. A tack board is also needed. (Are marker boards available which are easy to clean, do not “ghost” over time and can be used with hypo-allergenic markers?)
15. Space to include periodic table wall chart.
16. Computer hookup at each individual lab station (two per station). If cabling will not be run, certainly conduit for future use should be added now.
17. Blinds to darken room.

Chemists' Prep/Chemical Storage Areas

A top priority is to have a separate prep area and chemical storage area.

Chemistry Prep Area

1. Ample storage space. (Be specific here. Do you want drawers, shelves, open or closed areas, etc.?)
2. Lots of counter space with a center island.
3. Fume hood, (36" or 48"?) with gas and electric connections. Are water and sink required?
4. Two large sinks, 16" × 20", with hot/cold water.
5. Ample electricity with GFI protection.
6. Gas jets. Specify number. Locations of gas jets to be determined at a later time.
7. Eyewash/body drench. Recommend Flinn number AP8731.
8. Ample, proper lighting.
9. Space for demineralizer.
10. Storage for carts. Needs at least 34" height clearance. Possible storage under center island.
11. Automatic dishwasher.

Chemical Storage Area

1. Wooden shelves fastened to the wall. Fixed position shelves 12" deep and 10" high. (What is the tallest bottle you would put on a shelf? Use this dimension.) Shelf lips on each shelf. Chemical storage should be no higher than 7 feet tall.
2. Flammable storage in approved NFPA/OSHA cabinets. See Flinn Flammable Cabinets.
3. Acid storage in approved OSHA cabinets. See Flinn Acid Storage Cabinets.
4. Ventilation with a complete air change every four hours. Ventilation must flow directly to the exterior of the building and nowhere near any intake ports.
5. Room should be fire rated. Double drywall ceiling and walls with a fire rated door. Door should hinge out and have self-return hardware and a sturdy lock.
6. Smoke detectors should be installed in the chemical storage area and nearby, well-traveled hallway. Both units should be line operated—if one goes off, the other goes off—alerting school staff to a problem in the chemical storage area.

Biology Rooms

1. Stations must be arranged so a maximum of working students can be observed. Four students will be working at a lab station. Whatever furniture arrangement is used must provide maximum visibility, optimum supervision, optimum student/teacher contact, optimum cooperative teaming among students. Are book storage bins in lab stations or are locking cabinets needed?
2. Demonstration desk with gas, hot/cold water, and ample electricity.
3. Ventilation. Air for lab ventilation shall directly flow into the lab from non-laboratory areas and out to the exterior of the building. The ventilation fan must remove air a minimum of eight air changes per hour or 3,200 cfm.
4. Electricity for all lab stations. Two each, two duplex outlets with GFI protection per station.
5. Large sinks, each 16" × 20", cold/hot water, acid resistant.
6. Fume hood, one per room. 48" long. Vented directly to the exterior of the building. Recommend Flinn SE9000 with SE9003 base cabinet. Hood should have water, gas, and electric connections.

7. Gas at each lab station.
8. Ample general storage is a must.
9. Student storage is required.
10. Black epoxy resin table tops.
11. Permanent teacher's desk with electricity and computer network connections for two monitors.
12. Space and electricity for incubator.
13. Chalk and/or dry erase board. Tack board also needed.
14. Computer hookup at each individual lab station. If cabling cannot be provided, provide conduit for future installation.
15. Gro-lite installed under cabinet in one section of room.
16. Blinds to darken room.

Biology Prep Area

1. Ample storage space. (Be specific here. Do you want drawers, shelves, open or closed areas, etc.)
2. Lots of counter space with a center island.
3. Fume hood, (36" or 48"?) with gas and electric. Are water and sink required?
4. Two large sinks, 16" × 20", with hot/cold water.
5. Ample electricity with GFI protection. Must support two ovens, two large hot plates, and a large autoclave.
6. Gas jets. Two each. Locations to be determined later.
7. Eyewash/body drench. Recommend Flinn number AP8731.
8. Ample lighting.
9. Space and electricity for refrigerator.
10. Tall cabinet storage with adjustable shelving for project storage.
11. Small growing room for plants. Accessible to natural light.
12. Space for demineralizer.
13. Storage for carts. Needs at least 34" height clearance. Possible storage under center island.
14. Automatic dishwasher.

Laboratory Design Floor Plans



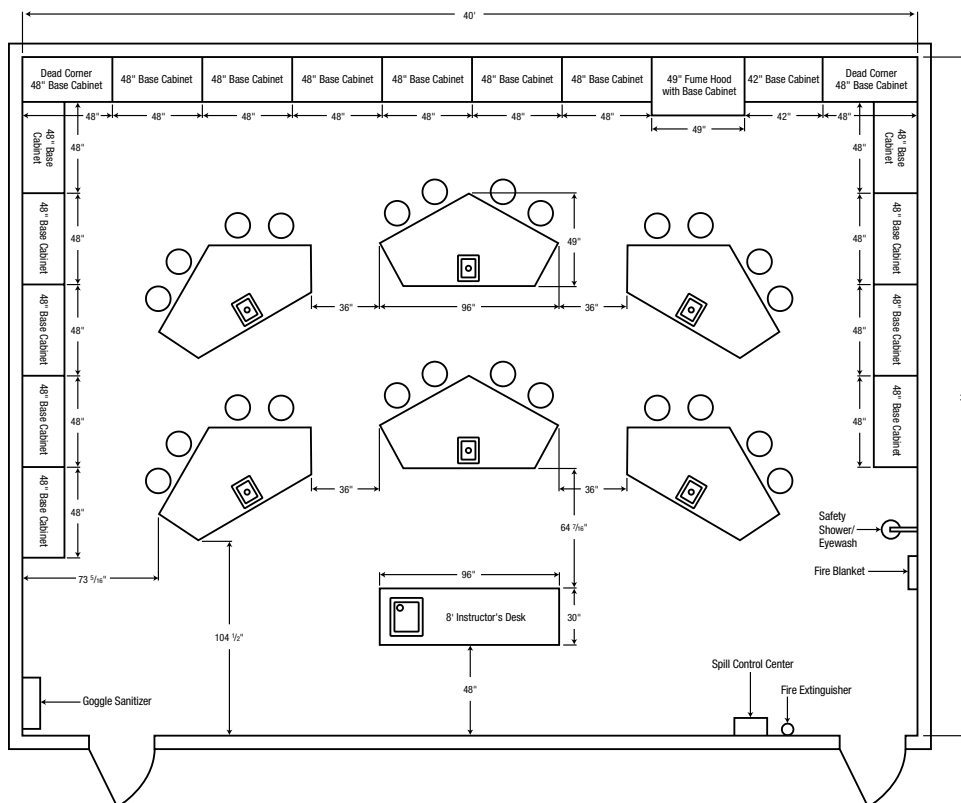
Flinn Scientific offers five standard laboratory floor plans but each can be customized to your specific needs. These designs are practical, cost-effective and maximize classroom supervision. Please call Flinn Scientific at 1-800-452-1261 to speak to a lab design specialist regarding additional options.

Combination Classroom/Laboratory

Room Size 30' x 40' — 1,200 sq. ft.

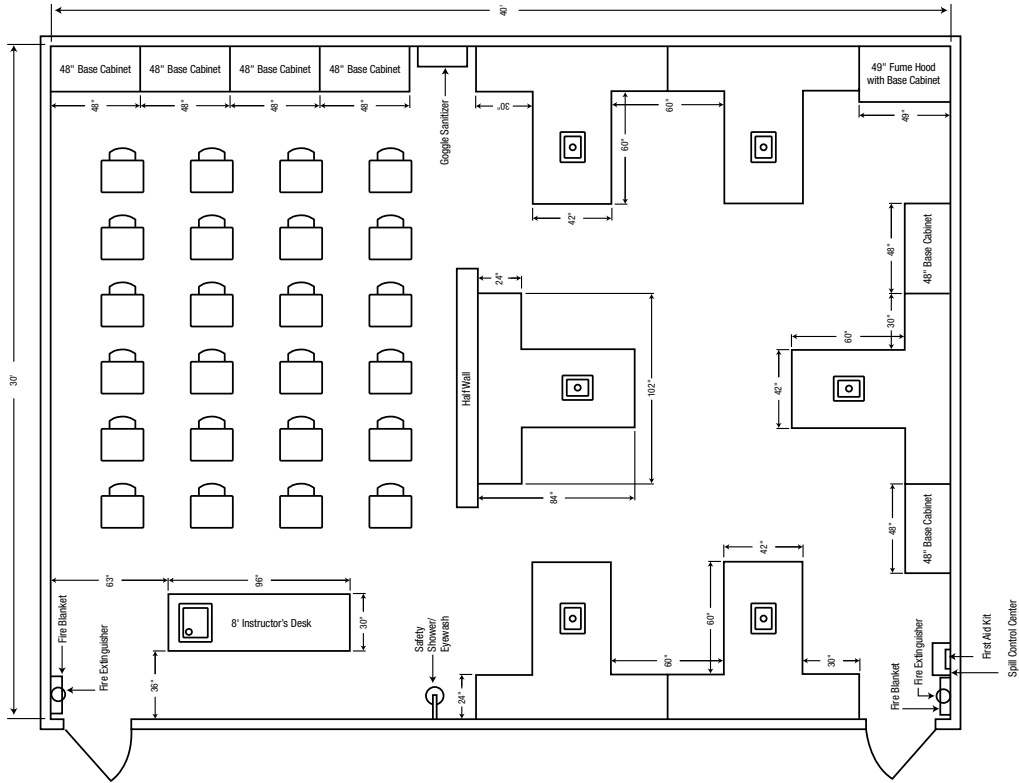
Benefits

- Pentagonal workstations provide ample workspace (96" across at widest point) to support all types of equipment and activities.
- Provides excellent sight lines to the front of the room for demonstrations and lectures.
- Workstation shape has students facing one direction, making supervision and demonstration easier for the teacher.
- Students sit on stools during class time. When lab activity starts, the stools are pushed under the lab table.
- Aisles are wide enough for foot traffic to flow freely and allow quick access to safety equipment.
- Plenty of storage space along the perimeter of the room and at each workstation.
- Fume hood is located away from busy traffic area.



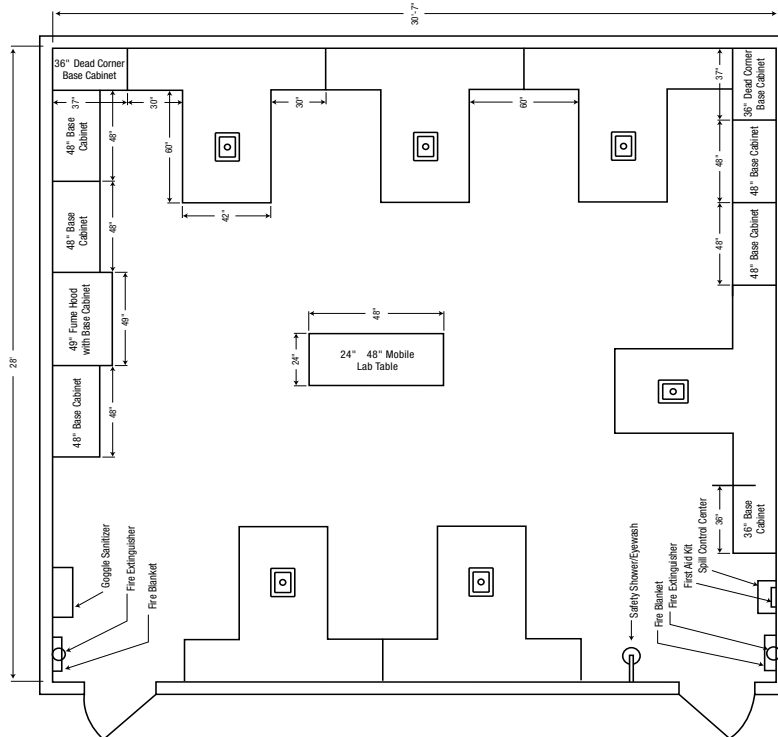
Combination Classroom/Laboratory—Divided

Room Size 30' × 40'—1,200 sq. ft.



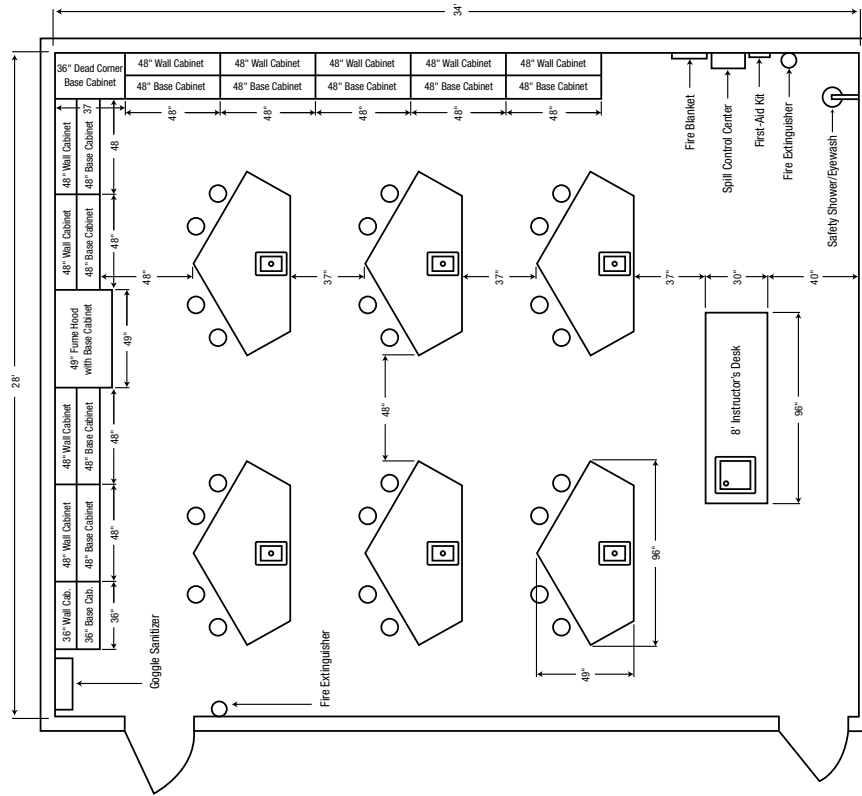
4-Student Perimeter Lab Tables

Room Size 28' × 30' 7"—840 sq. ft.



Combination Classroom/Laboratory—Compact

Room Size 28' x 34'—952 sq. ft.



Combination Classroom/Laboratory—Flexible

Room Size 38' x 30'—1,140 sq. ft.

