

Secondary School Science Laboratories
to prepare students for the 21st Century:
A set of resources for decision-makers

You will need to do evaluate the resources below because it matters what goals and what kind of an environment you have in mind.

First, from the Alabama Mathematics, Science, and Technology Initiative Committee comes this simple recommendation:

I. "Equip, update, and maintain all mathematics and science classrooms so teachers have easy access to appropriate materials, supplies, and technology necessary to deliver quality instruction.

Appropriate materials, supplies, and technology include, but are not limited to, the following:

- a) Manipulatives
- b) Activity kits
- c) Science consumables
- d) Science nonconsumables
- e) Literature
- f) Related media (videos, CDs, audiotapes, etc.)
- g) Computers (minimum ratio of one computer for every five students in each classroom (*desirable one to one, my addendum*))
- h) Internet access
- i) Calculators (grade appropriate)
- j) Software
- k) Peripherals (probe-ware, overhead calculators, data collectors, graph links, digital imaging and capturing devices, palm top interactive devices, etc.)
- l) Overhead *or computer* projectors
- m) Laboratory safety equipment"

II. A companion piece is the Fisher 47 question document (see Appendix A)
<https://www.fishersci.com/>

III. NEXT: The following responses come from several resources:

1. National Science Teachers Association

National Science Teachers Association, 1840 Wilson Blvd, Arlington, VA
22201703-312-9254, 703-243-0407 (fax) <http://www.nsta.org/>

NSTA has a publication that is relevant to the search entitled "**NSTA Guide to Planning School Science Facilities**"

(<http://learningcenter.nsta.org/search.aspx?action=quicksearch&text=NSTA%20Guide%20to%20Planning%20School%20Science%20Facilities>)

In fact, their website is full of publications about science facilities and infrastructure as well as teaching strategies and technology.

NSTA Guide to School Science Facilities, Second Edition

Motz, LaMoine L.; Biehle, James T.; West, Sandra S. (National Science Teachers Association; Arlington, VA, 2007)

The National Science Teachers Association, in response to the emergence of new science curricula and the need for updated science facilities in the nation's public schools, convened a task force to develop guidelines for K-12 science facility design and use. This guide, a result of NSTA Task Force on Science Facilities and Equipment, includes information about planning facilities design; budget priorities; space considerations; general room and laboratory design; and furnishings for the laboratory/classroom specifically targeting K-5, middle, and high schools. It is designed to familiarize educators, administrators, and citizens with the stages of the planning process for new and renovated science facilities and provides specific, detailed information on many aspects of the planning and design phases. Additionally, chapters address current trends and future directions in science education and safety, accessibility, and legal guidelines. Appendices include discussions on solar energy for school facilities, equipment needs planning, checklists, a glossary of construction terms, and classroom dimensional considerations. 148p.

There is also an e book version.

2. From the National Clearinghouse for Educational Facilities, Washington, DC

School Science Facilities--K-12 <http://www.edfacilities.org/rl/science.cfm>
NCEF's resource list of links, books, and journal articles on the planning and design of school science laboratories, including lab configuration, standards for ventilation, treatment of hazardous materials, and environmental concerns. Here are some resources from that list:

3. America's Lab Report: Investigations in High School Science., Singer, Susan; Hilton, Margaret; Schweingruber, Heidi (National Academies Press, Washington, DC, 2006)

Investigates factors that influence a high school laboratory experience, examining what currently takes place and what the goals of those experiences are and should be. The chapter on facilities calls for flexible space and furnishings that

combine features of traditional laboratories and classrooms, proper budgeting for the ongoing costs of equipment and supplies, and equitable distribution of facilities, equipment, and supplies. While maintaining student safety is a critical concern, little systematic information is available about safety problems and solutions. 235p.

4. Labs21 Design Process Manual

http://www.labs21century.gov/toolkit/process_manual.htm

(U.S. Department of Energy; U.S. Environmental Protection Agency, 2004)

Provides guidance on the design process for high performance laboratories, leveraging the Labs21 tools.

It includes the following:

1. A checklist of process-related action items for each stage of the building design and delivery process, with links to relevant Labs21 tools for each action item.

2. A “quick-reference” list of sustainable design strategies, with links to Labs21 EPC credits, Best Practice Guides, Design Guide, and Case Studies.

5. Science in Secondary Schools in the UK

http://www.ase.org.uk/htm/homepage/notes_news/january_2004/lab_des.pdf.

is a press release for The Laboratory Design for Teaching and Learning software which will enable both 2D and 3D images of science laboratories and prep rooms to be created by teachers and technicians. It is a communications tool that allows the sharing of ideas between science departments, architects and designers. The software also includes case studies and vignettes, and all the current national guidance on building and fitting out laboratories and prep rooms will be made available through a website and CD.

6. Labplan <http://www.labplan.net> (National Science Foundation, Washington, DC, 2003)

The NSF sponsored work by the National Academies and a pdf of a PP is available which has some interesting physical models.

7. Science Facilities Fabrication <http://www.cpm labfab.com/>

This comes right from their website: CPM LabFab manufactures C.O.S. (constructed off-site) custom laboratories. Depending on your building design, you can have significant research or production expansion in a matter of weeks.

For additional information, Jenni Woolums is a good contact. Reference Services National Clearinghouse for Educational Facilities 1090 Vermont Avenue, NW, Suite 700, Washington DC 20005 Phone: 888-552-0624 or 202-289-7800 Email: jwoolums@nibs.org Web: <http://www.edfacilities>

IV. Vendors

1. **Fourier** responded with six documents which can be found on their web page. Their bundles come with prices attached so you can begin to calculate the costs. Click on Bundles in the left hand navigation box.

Brenda Raker, CEO,
Fourier Systems, Inc. Office: 812.206.2334, Fax: 812.206.2384
www.fourier-sys.com

2. Sargent-Welch

Brian W. Kirsch, Regional Account Manager-New England told me that he provides advice and counsel for "...complete solutions and time-saving tools for planning, designing, and furnishing your space. We simplify the process for you with a focus on service, safety, and state-of-the art equipment..." He also listed nine local sites, mostly community colleges and private schools in New England where Sargent-Welch has done work.

Brian_Kirsch@VWREducation.com
<http://www.sargentwelch.com/>

3. **Vernier's** website is full of resources: <http://www.vernier.com>

A complete list of their equipment is available here:<http://www.vernier.com/products.html> They also recommend that you check out the getting started guide here:<http://www.vernier.com/go/gettingstarted.html> I hope this helps.

Contact Erik Schmidt, Vernier Software & Technology
13979 SW Millikan Way
Beaverton, OR 97005-2886
phone: (503) 277-2299 fax: (503) 277-2440

4. **Pasco** responded after the paper was posted.

Here is their information: "Our mission is to serve teachers and to provide complete technology solutions for science teachers. Our website and technical education representatives provide detailed product descriptions and recommendations plus curriculum and content support. Contact, Lara Sharp New England Education Technical Representative PASCO scientific (800) 772-8700 x508 Fax: (508) 302-1069 lsharp@pasco.com <http://www.pasco.com>

Appendix A: 47 Questions and Tips to Define Your Lab Needs from Fisher Science Education

1. Will the laboratory have a fume hood? Fume hoods are required for chemistry and all other labs where hazardous or vaporous chemicals are used. Will the fume hood have gas, electricity, water, and a sink? Where will the fume hood be located in the laboratory?
2. What ventilation needs will you have? If the laboratory is mainly for chemistry, then you should have adequate ventilation to turn over the air four (4) times every hour to clear any fumes or smoke that may occur in the area. Controls should be manual because the unit does not need to run continuously. A fume hood does NOT provide adequate room ventilation.
3. What variety of table and counter surface tops do you need, e.g., plastic laminate/chemarmor/epoxy resin?
4. What type of floor surface should you have, vinyl/epoxy/ceramic?
5. Are you considering a handicapped-accessible lab station? Is it mandated by code?
6. Will you have LAN, Cat5, and computer cables running to the lab station for use with computers, probeware, or interfaces?
7. Do you have adequate electrical service with ground-fault interruption in all areas in the lab?
8. Will you need storage for personal protective equipment? And will this storage need to have sanitizing capabilities?
9. Will the laboratory be a single-purpose or multiple-purpose area, e.g., chemistry/biology or physics/earth science?
10. Do you have ample storage for apparatus and other equipment? Is it lockable?
11. Do you need a combination of mobile and stationary storage?
12. What type of demonstration area will you need? Will it be mobile or stationary? Are electrical, water, and gas needed?
13. Are sinks a usable size? Do you want hot and cold water at each lab station?
14. Do you need location placards/signs to mark all safety equipment?
15. Do you need non-reactive waste receptacles? Fireproof waste cans?
16. Where will spill control materials be stored in the chemistry lab?

17. Do you want laboratory stools or chairs, and are they the correct height for your furniture?
18. Do you want dry erase or chalkboards in the lab? Where do you want them located?
19. Does your state require two (2) exits? If so, where will they be located? Do exit doors have adequate locks and self-closing return hardware?
20. Does the laboratory have ample lighting of 75 to 100 foot-candles at work surface level?
21. Does the demonstration area have good line-of-sight for the instructor? Can the instructor see most of the activity from one vantage point? Can the instructor move easily from one lab station to another without being hindered by students, desks, and chairs?
22. Are master utility cut-off valves for gas and electricity available, easily accessible in case of emergency, with location placards/signs?
23. Where will the fire blanket/fire extinguisher (ABC type), eyewash, and a shower or body drench (with drain) be located in the laboratory? Do you need multiple stations depending on where the teacher's demonstration table and prep area are located in relationship to the general lab?
24. Is the preparation area designated for one laboratory area, or is it a combinations/multiple lab area?
25. Does the preparation area have full utilities? Gas, electrical, and water?
26. Does the preparation area require separate fire blankets, extinguisher, eyewash, and body drench stations?
27. Does the preparation area have storage for spill containment materials?
28. Will you need approved acid/corrosive storage cabinets in the area and can they be vented to the outside?
29. Will you have approved flammable storage cabinets?
30. Does the preparation area have ventilation capable of cycling the air four (4) times per hour?
31. Are smoke detectors in the preparation area?
32. What type of flooring is in the preparation area, e.g., vinyl, concrete, epoxy, coating?

33. Is the storage area lockable with self-closing hardware?
34. Is there proper signage and markers, e.g., "Authorized Personnel Only?"
35. Are all chemicals stored below the height of six (6) feet?
36. Does the preparation area have water distillation or de-ionizing capability?
37. Will the preparation area have a commercial dishwasher for clearing and sterilizing lab ware?
38. Does the area have enough counter space for preparation?
39. How much mobile and stationary storage is needed for apparatus and hardware? Mobile storage is easier to work with but has limitations on the amount that can be stored in any one unit.
40. Will you use laboratory carts? If so, will there be adequate area for storage of the carts in the preparation area?
41. Will a stepladder be available to access materials stored off the floor?
42. Are drying racks planned, and will there be adequate drainage?
43. Are communication systems in place, and are they easily accessible in case of an emergency?
44. For safety considerations, is it possible to store chemicals in a separate, continuously ventilated area that is adjacent to the preparation area?
45. Does the area have automatic emergency lighting in case of a power outage?
46. Are first-aid materials present and easily accessible in the prep and lab areas?
47. Does state law require the installation of an acid dilution trap in the area, and if so, how will it be maintained?