

School Science Facilities Planner

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Science education comprises an essential component of the North Carolina Standard Course of Study. That document sets forth goals that can enable the student to become scientifically literate and have a substantial knowledge of the concepts, conceptual networks, and process skills that can equip him or her to continue to learn and think logically. It is widely recognized that a scientifically literate society is essential if this state and the nation are to successfully compete in an increasingly broad, complex and technological society.

As is the curriculum described in the North Carolina Course of Study, facilities that appropriately support safe and effective instruction in the sciences are essential to providing each student optimal opportunities for learning. A growing body of research shows positive student performance implications related to school climate and order—variables directly attributable, in part, to facilities design. Well-designed science facilities can enhance both the teacher’s ability to teach and the success of the student’s learning experience.

This publication describes science programs and facilities and is a supplement to the North Carolina Public School Facilities Guidelines. It is a resource that can assist design professionals to plan facilities that effectively meet the evolving needs of public schools in North Carolina. We hope you find it useful.

Note: A major change in the Science Facilities plan review process was implemented due to a recent General Statute requirement. As a result of this new legislation, in its March 2010 meeting, the N.C. State Board of Education approved the “Middle and High School Science Safety Standards” (Appendix “A” in the rear of this publication). This board policy requires that DPI, School Planning review and approve all Middle and High School Science projects for safety. This approval must be in place before these facilities can be occupied.



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Contents

Foreword	iii
Acknowledgements	iv
Introduction	2
Background and Overview.....	2
Science Education.....	2
Using the Facilities Planner.....	2
Facilities Design	3
Classrooms.....	3
Laboratories.....	4
Teacher Work Stations.....	4
Storage Areas.....	4
Outdoor Spaces.....	5
Shared Spaces.....	5
Safety and Security.....	5
ADA Guidelines.....	6-7
Programs and Facilities	8
General Requirements.....	9-11
Elementary Science.....	12-16
Middle Level Science.....	17-19
Biology.....	20-22
Chemistry.....	23-25
Earth / Environmental Science.....	26-27
Physical Science.....	28-29
Physics.....	30-32
APPENDIX “A”: CHECK-LIST FOR SCIENCE SAFETY REQUIREMENTS (Required <u>Approval</u> by NCDPI School Planning)	33-38
APPENDIX “B”: Optional check lists to aid LEA’s in assessing their science facilities	39
Sample Checklist: Elementary School Science (Adapted From National Science Teachers Association)	40-41
Sample Checklist: Middle School Science (Adapted From National Science Teachers Association)	42-43
Sample Checklist: High School Science (Adapted From National Science Teachers Association)	44-45
Facilities Resources	46
Resources	46
Regulatory References	47

Introduction

BACKGROUND AND OVERVIEW

Each school day nearly 1.45 million children enter classrooms in the public schools of North Carolina. Even for the youngest child, science is a vital part of the curriculum and is taught regularly throughout the year. Developmentally appropriate, integrated instruction in earth, life, and physical sciences follows the student through the conclusion of the public school experience. The design professional will face the challenge of melding necessary physical components that can support classroom and laboratory science instruction into a facility shared with programs and services in other curriculum and support areas. Provision for the child with special physical or educational needs presents additional and unique considerations to the design process for an integrated facility. The most effective facility design will reflect a marriage of sound program planning by school system personnel and knowledgeable, inventive application of design principles by the design professional and will embody flexibility sufficient to sustain current and emerging approaches to providing science instruction. These planning guidelines are intended to enhance that endeavor.

SCIENCE EDUCATION

The mission of science education in the public schools is to ensure that all students become scientifically literate—that is, that they possess a substantial knowledge of concepts, conceptual networks, and process skills that enable continued learning and logical thinking. Program strands and goals for science education provide the basis for the curriculum and include (1) the nature of science, (2) science as inquiry, (3) science and technology (4) science in social and personal perspectives, and (5) science concepts. These program goals are the source for all science education objectives. The Science Curriculum is offered through integrated study of the identified program goals in the areas of earth, environmental, life, and physical science. Recent advances in science and technology are highlighted throughout. The student gains a broader and more comprehensive understanding of program goals as the grade level advances. From the student's earliest exposure, experiential learning is recommended. An experiential, inquiry-based instructional program is essential to student understanding of science at all levels, beginning with the lowest grades. In this way, science program goals are achievable by all students and can provide the student with a rewarding learning experience and a sense of accomplishment.

USING THE FACILITIES PLANNER

This publication is intended as a reference document for designers of public school facilities.

Its purpose is to provide descriptions of school science programs and the facilities that can support them. It is neither comprehensive nor all-inclusive, but provides an initial understanding of the nature and purposes of instructional programs around which facility designs may evolve. The guidelines supersede neither state nor local codes or regulations, nor federal or state legislation regarding building design and construction, access, safety, or other pertinent issues. **Note that General Statute 115C-81.4 and 115C-521(C1) requires the State Board of Education to approve middle and high school science facility plans for safety (through DPI, School Planning Section) before a certificate of occupancy is applied for.** Some aspects of all science programs and facilities are similar in nature and are described in the introductory portions of this guide. Subsequent sections focus on the peculiar requirements of individual courses or program areas. Sample floor plans supplement and clarify printed descriptions and are not intended for direct replication within facility designs. Because it is a policy of the National Science Teachers Association that classes greater than 24 students in size pose a potential safety risk, sample plans shown in this guide are designed accordingly. Local program requirements and available state and local resources should be considered in determining student capacity for actual facilities design. As a design takes shape, it is likely that additional, more detailed information will be needed about the programs, equipment, and purposes that will function within the facility. Several resources that should prove useful are provided in the Additional Resources section near the end of the publication. In addition, staff consultants with the Science Education Section of the North Carolina Department of Public Instruction are available to discuss areas of concern.

Facilities Design

Designing school facilities challenges the collective planning skills and creativity of educators and design professionals. Providing desirable learning environments for a variety of science education programs can introduce particularly complex issues into that collaboration. At least two unique characteristics of science education facilities emphasize the importance of good design decisions. First is the high cost of space and equipment, relative to that for most other teaching stations in a school. The required volume of space for laboratories will significantly exceed that for a lecture setting, while equipment costs may be many times greater. Second is the inflexibility of some laboratory designs. Facilities may require relatively large floor spaces with special infrastructure. Such facilities may be less flexible, in that they can be very expensive to renovate and poorly located for some other uses. In general, laboratories can more easily be converted to other types of laboratories than spaces for purely classroom use. This section identifies design considerations that are common to most school science facilities. Requirements unique to specific facilities are described in a subsequent portion of the publication.

Classrooms

Each program will require access to classroom space sufficient for anticipated student enrollments. Classrooms will serve as assembly areas where students may receive group instruction, plan, research, use audiovisual materials, and access computer resources. In situations where several laboratories are located in proximity and classrooms are shared, a small assembly area may be considered for each laboratory.

Most elementary science will be taught in the regular classroom, which should contain a minimum of from 1,000 to 1,200 square feet. A designated multi-discipline project room of approximately 1,000 square feet, to serve more than one program (e.g., science, art, math, social studies), can enhance the elementary science program. National Science Teachers Association (NSTA) recommends 1,080 square feet for a multiple use elementary multiple-use science classroom or 45 square feet per student. A separate, lockable storage area for each discipline should be provided.

Regular classrooms for grades six through eight should contain a minimum of from 850 to 1,000 square feet; regular classrooms for grades nine through twelve a minimum of from 750 to 850 square feet. If a classroom is combined with a laboratory, significant additional area is required. Classrooms smaller than 1,000 square feet should not exceed a 3:2 length-to-width ratio, with a minimum width for any such space of 24 feet. The National Science Teachers Association (NSTA) recommends 1,440 square feet for a multiple use middle or secondary multiple-use science classroom or 60 square feet per student.

The Typical classroom space should have dry marker and tack boards, individual student tables and chairs, a demonstration table, and a teacher desk and chair. A conference table for six should be considered, and should be separated from the classroom by a transparent partition. Ample storage for audiovisual equipment and materials, printed instructional resources, and teacher and student files should be provided. A minimum of one permanently mounted television monitor or projector should be provided, as should cabling and outlets for computers and other communications systems. Room size should be increased by 15 to- 20 square feet per computer, and future usage of computers and other technology should be considered in sizing and equipping spaces. Natural light should be controlled to permit the use of television and other instructional technology. A communications system, to include a telephone, shall be provided for informational and emergency use.

Exterior classroom windows should equal at least six percent of the floor area, and, if the building is not sprinklered, with a minimum of one that can be used for ventilation or emergency rescue. This window must be operable from the inside and provide opening dimensions of at least 20 inches wide and at least 24 inches high and no less than 5 sq. ft. for on-grade floors and 5.7 square feet for above grade floors. Maximum sill height shall be 32 inches through grade five and 44 inches for grade six and above. An exterior door may be substituted for this window.

Classrooms without an exterior wall should have interior windows into a laboratory or similar space to provide an ample daylight source. With certain exceptions, classrooms without exterior windows shall provide a secondary exit, either directly or through an adjoining room, to an exit corridor that is separated by one-hour rated construction from the primary exit corridor.

Laboratories

While multi-purpose science laboratories may be necessitated by exceptionally small school sizes, in general, science laboratories are custom designed for specific programs. Laboratories should provide work environments in which practical application of instruction and skills practice may be accomplished effectively and safely. Floor area is determined by the peculiar purposes and nature of instruction. The National Science Teachers Association (NSTA) recommends the following: A minimum of 45 square feet per individual for laboratories, exclusive of storage and preparation rooms, and a minimum of 60 square feet per individual for lab / classroom combinations, provides good planning figures. Ceiling height should be at least 10' - 0".

Supply and equipment storage should be located convenient to work areas so that a minimum of travel and congestion results. Wide aisles should be positioned between work stations, in front of storage cabinetry, and around fixed equipment. Equipment and casework should be positioned for ease of cleaning around their bases, and cabinets should fit flush to walls for the same reason.

Windows in a laboratory can provide natural lighting that, at times, may be sufficient for student investigations and thereby reduce energy costs. Natural lighting may also be of value during emergencies or exits from the building during power failure. Vinyl tile is usually suitable for laboratory floors. A floor drain shall be provided in the vicinity of the emergency shower/s.

Safety equipment shall include eye goggle sanitation cabinets and emergency eye wash fountains and/or combined flexible eyewash / drench hoses (North Carolina G.S. §115C166 (1668)). A master gas cut-off valve or switch, shall be provided where laboratories are equipped to use gas. A master cut-off switch for electrical power shall be provided. Fire extinguishers shall be provided in each laboratory, as well as, a two-way communication system for informational and emergency use.

In chemistry laboratories, a combination emergency deluge shower and eye wash shall be provided. Chemistry laboratories shall also be equipped with teacher-controlled fume hoods. Chemical storerooms and teacher prep areas shall be designed to exhaust six air exchanges per hour continuously.

Teacher Work Stations

Each teacher should have a work station which comprises, as a minimum, an adequately lighted desk-height work surface with computer terminal and telephone, chair, a lockable legal-size filing cabinet, and a secure locker for storage of teaching materials and personal items. In secondary schools particularly, while an occasional private office may be justified, teacher work stations are often located in common areas.

Work areas should be equipped with shelf space for books and other printed material and storage for audiovisuals and other teaching aids. One or more tables with chairs can contribute to the flexibility and utilization of the area. Teacher workrooms for the preparation of instructional materials should be located adjacent to the work station area.

Storage Areas

Storage is required for equipment, materials and supplies, and for some student projects. Where laboratories utilize shared storage facilities, cabinetry and shelving should reflect the peculiar needs of each. Secure storage that meets all safety and fire codes must be provided for chemical or other hazardous supplies. Materials storage requirements will vary with the type of investigations, but should be located convenient to the materials receiving door and in a location that provides an orderly flow of materials into the work area. Note: All storage cabinets in prep rooms should be master keyed.

Inexpensive equipment, tools, or utensils that receive frequent use are often stored in wall panels or cabinets for easy accessibility and inventory. More expensive items, especially those that are used only occasionally, will require a lockable storage room or cabinet. Storage areas may be used to isolate noisy laboratories from adjacent quiet areas. Each teacher will need a lockable storage cabinet or closet for securing instructional materials and aids in the laboratory, particularly where the permanent teacher work station is located in a common area not contiguous to the lab.

Outdoor Spaces

Spaces outside the building can be essential to the successful implementation of certain science curricula as instructional areas or laboratories. Such spaces will be tailored to the curricula of selected courses or programs and, while an integral part of the facility design, may not occur in proximity to the building proper. Examples of outlying spaces include land labs, nature trails, and greenhouses.

The school site holds great instructional potential for science and a number of other subjects, and should be designed with science education and environmental learning in mind. Effective schoolyard habitats can utilize, by design or enhancement, trees, meadows, ponds and wetlands, and other environmental elements.

Shared Spaces

Flexibility in facility design encourages space sharing, which can increase utilization and reduce costs. A single classroom, as an example, may serve two or more laboratories. Another means of increasing flexibility is through the sharing of special equipment or work areas, depending upon the size of the school. A third alternative would have two or more programs sharing a single laboratory space, but with materials storage spaces for each. However, a centralized chemical inventory system is imperative for safety. Note that some subject areas require special safety features. Be sure that shared spaces provide for the most restrictive requirements as described later in this publication.

Space sharing need not necessarily be limited to science programs. A greenhouse, for example, might be shared among science and horticulture classes. Shared curriculum support areas such as conference rooms, career resource rooms, and computer labs offer other venues for efficiency in design. Carpet is not a suitable floor covering for any science classroom.



**Science laboratories should only be used for science instruction.
Science teachers should not be teaching science in a non-science room.**

Safety and Security

Security of science education facilities and equipment is of primary concern from economic, accountability, and liability perspectives. Gas activation switches should have locks with the teacher retaining a key. Controlled access to classrooms, file servers, laboratories, and support areas should be assured in the design of the facility.

In chemistry laboratories or anywhere that hazardous chemicals are used, an emergency deluge shower and eyewash is required, (29 CFR §1910.1450(C)(1)(d); §1910.151(C); ANSI Z358.1-2004 No consideration in facilities planning is more important than safety. School planners should keep abreast of current statutes and codes related to building and occupant safety as they relate to the design of science education facilities. Light switches shall be located outside of the chemical stockroom door to prevent possible sparking inside the storeroom.

REQUIRED SAFETY FEATURES FOR SCIENCE FACILITIES

N.C. General Statutes (G.S. 115C-81.4, and 115C-521 (c1) require that the N. C. Board of Education (through DPI, School Planning) approve public school science plans for safety. Approval is required prior to occupancy. The LEA is responsible for training the staff and maintaining the systems and equipment to enhance safety. (See “Check-List For Science Safety Requirements” in the back of this publication) (Appendix A)

Americans with Disabilities Act (ADA) Guidelines And The Accessibility Building Code

(Source: NSTA Guide to School Science Facilities) Since good science experiences are important for the student, they must be available to each student. Restricting the disabled or physically challenged student to different facilities is illegal. The obligation to accommodate persons with disabilities increases when renovations are planned.

The 1977 Individuals with Disabilities in Education Act (IDEA) defines the rights of the special education student in US schools. IDEA mandates the inclusion of the student with disabilities in school programming more clearly than ever before. All science classrooms should be built to accommodate each student who chooses to study in them. Providing wheelchair access, communication devices for the hearing-impaired student, and Braille assistance for the blind student in regular science classrooms must be considered in planning and building today's school facilities. Co-teaching by special educators in the regular classroom is becoming more common and is being incorporated into best practice, since it is difficult to prove that studying a laboratory science in a special education classroom provides equal opportunity to learn.

The American Disabilities Act of 1990 (ADA) defines standards for physical access to facilities for all persons, including students and teachers who use public buildings. For purposes of the Act, a handicap is defined as a "determinable physical or mental characteristic of an individual which may result from disease, injury, congenital condition of birth, or functional disorder which is unrelated to the individual's qualifications for employment or promotion."

Guidelines for applying the ADA are found in the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG). They are enforced by the Department of Justice. Because the ADAAG regulations are not specific to science facilities, some interpretation is required. The recommendations in this publication include regulations and adaptations of related guidelines.

Generally, architects are familiar with the basic requirements of accessibility. Many schools built before 1990 are not accessible to disabled persons. While these schools may remain compliant by making reasonable progress toward expanded access, they have an obligation to provide complete accessibility when they start a renovation. Typical deficiencies found in older buildings include steps, narrow doors and aisles, a lack of elevators, workstations that cannot be used by the student in a wheelchair, and controls that require movements that are not possible for persons with disabilities.

The ADA requires that existing deficiencies be corrected as each area in the building is renovated. A percentage of the renovation costs must be spent on upgrading the remainder of the building along the path of travel from the entrance to the renovated space. Doors and aisles must be wide enough for wheelchairs (32" for doorways and 36" for aisles), toilet facilities must be wheelchair accessible, and emergency facilities must be built at appropriate heights on all new construction.



It is important to keep the aisles and floor space cleared. Occupational Safety and Health Administration (OSHA) 29 CFR §1910.23(c)(1) was in the top 10 OSHA violations in 2005.

Each area of the school used by any student must have access for physically disabled persons built in during new construction. A person in a wheelchair should be able to move without assistance from the parking lot to every essential area of the school. In science laboratories, this often means adjusting the height of some laboratory facilities and sinks, widening aisles, and relocating equipment. The dimensions given in the following are the adult requirements, which apply to persons age 13 or older.

laboratory workstations: Many equipment manufacturers have developed workstations with lowered decks and lever, push-button, or electronic controls that can be used in place of regular lab stations to accommodate disabled students. These stations may be equipped with water, gas, electrical power, and sockets for apparatus rods. Controls should not require tight grasping, pinching, twisting of the wrist, or exerting more than five pounds of force to operate. If mobile workstations and portable equipment are used, space to accommodate them should be provided in every laboratory.

laboratory sinks: Laboratory sinks are a special challenge because the ADAAG specifies a sink depth of no more than 6.5 inches so that a wheelchair can sit under the sink without having the sink too high. The sink's rim must be at a maximum height of 34 inches for adult students. This leaves little space for a heavy sink assembly. A minimum vertical knee space of 27 inches and knee-space width of 30 inches are prescribed. Sinks must have lever-controlled faucets or a similar alternative.

Fume hoods: Fume hood manufacturers seem to have lagged behind. They have lowered decks to the necessary 34-inch maximum, but many have yet to develop the necessary controls. Knee space requirements for seating at a fume hood are the same as for sinks. It is desirable for fume hoods to have 3-4 transparent sides for student observation.

Safety showers and eyewashes (ISEA Z358.1):

The standard emergency shower / eyewash unit has the eyewash bowl mounted 38 inches above the floor, and the pull handle for the shower at about 68 inches above the floor. Assuming that the shower can be side accessed, these can be modified to approximately 32-34 inches and 54 inches, respectively, to accommodate disabled, as well as other students. The objective is to have the eyewash spout height at a maximum of 36 inches above the floor — the standard for a drinking fountain. If there is a second shower or eyewash in the room, these may be at standard height. A flexible-hose combined eyewash / drench hose unit may be installed at the lab station.

Other adaptations: Wall cabinets are a potential hazard for students and teachers with disabilities — particularly to those who are visually impaired. Sharp or unexpected corners should be avoided, and all upper cabinets should have base cabinets beneath them. It is advisable to build in wiring for communication equipment for hearing-impaired students so that electronic aids can be easily installed.

Some guidelines for children 12 years old or younger are also available. For planners, the key factor to remember is that accessibility for students with disabilities is mandatory (NC Building Code Chapter 11, "Accessibility").

NOTE TO DESIGNERS:

The Americans with Disabilities Act of 1990 (ADA) is civil rights legislation and is enforced by the U.S. Department of Justice. Standards for applying the ADA are found in the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG). The N.C. State Building Code (NCSBC) by General Statute is administered and enforced by the Commissioner of Insurance and sets forth the minimum requirements for buildings to promote safety and performance. The more stringent accessibility requirements of the ADAAG or NCSBC must be followed.

Programs and Facilities

The following pages describe science programs, systems and equipment requirements, and provide sample floor plans for clarification purposes only. Sample floor plans supplement and clarify printed descriptions and are not intended for direct replication within facility designs. Because it is a policy of the National Science Teachers Association that classes greater than 24 students in size pose a potential safety hazard, sample plans shown in this guide are designed accordingly. Local program requirements and available state and local resources should be considered in determining student capacity for actual facilities design. Please visit www.schoolclearinghouse.org to see examples of actual facility designs.

The goal of the North Carolina Standard Course of Study (NCSCOS) for Science is to achieve scientific literacy. The National Science Education Standards define scientific literacy as “the knowledge and understanding of scientific concepts and processes required for scientific decision making, participation in civic and cultural affairs, and economic productivity.”



The tenets of scientific literacy include **the ability to:**

- Find or determine answers to questions derived from everyday experiences.
- Describe, explain, and predict natural phenomena.
- Understand articles about science.
- Engage in non-technical conversation about the validity of conclusions.
- Identify scientific issues underlying national and local decisions.
- Pose explanations based on evidence derived from one’s own work.

North Carolina students can achieve scientific literacy through an instructional program based on the science component of the Standard Course of Study for Science. The NCSCOS is designed to merge unifying concepts of science, strands, content goals, and objectives.

These unifying concepts are:

- Systems, Order and Organization
- Evidence, Models, and Explanation
- Constancy, Change, and Measurement
- Evolution and Equilibrium
- Form and Function

The strands, common to all grade levels and content areas, include:

- Nature of Science
- Science as Inquiry
- Science and Technology
- Social and Personal Perspectives

The K-8 Science program includes goals and objectives from Life, Physical, and Earth Sciences each year. The Secondary School Program (Grades 9-12) is based on discipline-specific courses including Biology, Chemistry, Earth / Environmental Science, Physical Science and Physics. Advanced courses including AP[®] and IB courses are encouraged.

GENERAL REQUIREMENTS (See Appendix “A”)

General Lab / Classroom

- Student lab furniture/built-ins with acid-resistant tops and sinks to suit the curriculum / subject area, based on one sink per 4 students in each lab.
- Space between furniture, built-ins, etc. enough for safe circulation of teacher and students.
- At least one student lab work station per lab meeting ADA requirements.
- Teacher demonstration table in each lab and each science classroom.
- Wall cabinets always located above base cabinets
- Wall cabinets located above sink cabinet: Bottom of wall cabinet 5 feet minimum above finished floor.
- Dry erase marker boards. Avoid chalk boards (chalk dust is harmful to students and equipment)
- Provide storage for students' coats and book bags.
- For middle school and high school, provide a separate, manually controlled emergency exhaust system for each science room except that dedicated to physics. System shall be sized to exhaust a minimum of six air changes per hour.
- Chemistry labs: work surface at standing height.

Preparation / Storage Room

- Location convenient to Lab / Classroom (preferably adjacent)
- Provide locking doors
- Provide lips on shelves in seismically active areas
- No hazardous chemicals stored in Preparation / Storage room unless they are in commercial, specially designed, locked cabinets. (separate cabinets for acids, flammables and corrosives)
- Provide a continuously operating exhaust system sized to exhaust a minimum of six air changes per hour. The fan shall be spark proof.
- Laboratory grade dishwasher.
- Space for refrigerator (one spark-free refrigerator per high school science department and located convenient to the chemistry or biology lab)
- Warm water at sink. Goose neck type faucets are recommended.
- Chemicals that are water reactive, stored in buildings with sprinkler systems, shall be stored in protected rooms / cabinets to prevent any contact with water. Refer to NFPA 45 for guidance.

Chemical Storage Room

- Chemical Storage room access is preferred to be through the Preparation Room. This room can be a part of the preparation room's overall square footage
- Locking, fire rated door, swinging outward (door hardware always allows passage from inside room)
- Provide commercially available, separate chemical storage units for acids, flammables and corrosives ventilated or not as recommended.
- Do not store non-compatible and/or corrosive chemicals above other chemicals
- Shelves and cabinets
 - Properly secured to wall
 - Corrosive resistant materials
 - 12 inch maximum depth (store only two rows of containers)
 - Provide lip on shelf edges
 - Positive cabinet door latches that will withstand a seismic event.
- MSDS (material safety data sheets): consideration shall be given as to where these sheets will be displayed inside and outside this room.
- Provide a continuously operating exhaust system sized to exhaust a minimum of six air changes per hour. The fan shall be spark proof.

- Chemicals that are water reactive, stored in buildings with sprinkler systems, shall be stored in protected rooms / cabinets to prevent any contact with water. Refer to NFPA 45 for guidance.
- Chemical storage room light switch shall be located outside the room and no receptacles are to be installed inside of room.

Safety Equipment / Systems

- Fume Hoods
 - Required for high school chemistry.
 - No ductless hoods or hoods requiring internal filtration are allowed.
 - A free standing or bench top hood with four transparent sides (only one open operable side) is recommended.
 - Each hood shall be individually exhausted directly to the outside, sufficiently remote from air intakes or building openings. All ductwork shall be stainless steel.
 - Hood shall be located where effectiveness will not be jeopardized by:
 - Air supply distribution (air flow) patterns
 - Teacher / Student walking past hood (avoid high traffic areas)
 - Thermal convection
 - Opening of doors and windows
 - Air Flow for each hood shall be designed / operated as recommended by the hood manufacturer. This recommendation must take into account the location of the hood in the classroom or preparation room and air distribution in the space. An average minimum velocity of 100 linear feet per minute shall be maintained across the face of the hood.
 - Sufficient makeup air shall be provided as required to ensure proper operation of the hood. This can be accomplished by hoods with auxiliary air, building surplus air or a separate source specific to each hood.
 - Provide each hood with an air flow monitoring device that continuously provides confirmation of proper hood performance and sounds an alarm when the airflow is out of tolerance.
 - Exhaust fans shall be spark proof and located outside the building envelope
- Eyewash and safety showers are required in each middle school and high school science room not dedicated to physics. Eyewash stations are required in all preparation rooms and recommended for elementary school science rooms.
 - Maximum travel distance from every work station:
 - Eye Wash: 25 feet (within 10 seconds of each work station)
 - Shower: 50 feet
 - A minimum of one eyewash and shower shall be handicap accessible
 - Each eyewash and safety shower shall be supplied with luke warm water. Provide a mixing valve for each individual or group of closely located safety equipment. Water temperature shall be adjusted to be in compliance with ISEA Z358.1
- Provide a fire extinguisher (ABC) and fire bucket; sand for metal fires
- Provide safety cabinet/s for storage of goggles, heat and acid resistant gloves and chemical resistant aprons, etc.
- All chemical storage cabinets shall be vented or not per the cabinet manufacturers recommendations for the type of chemicals being stored.
- All plumbing fixtures located in the lab or preparation room shall drain through a local dilution or neutralization device, or drain into a central acid waste system that is constructed of acid resistant materials. Fixture drains shall drain through a dilution or neutralization tank before entering the sanitary sewer system. Central tanks shall be located outside of the building and sufficiently away from building openings. All plumbing fixtures and dilution / neutralization devices shall be directly connected to the drain system. Local dilution or neutralization devices shall be installed in such a way as to ensure proper access to utilities located in case work and to avoid obstruction of ADA required access space. All fixtures and piping upstream of dilution or neutralization shall be acid resistant.
- Provide GFI protection for all outlets in the laboratory and preparation rooms.

- Provide a single emergency (mushroom type) shut-off switch in each science lab / classroom that will close valves in the gas, water source serving each particular science lab / classroom; (except that serving emergency showers and eye washes) and interrupt all power (excluding overhead lighting, exhaust systems and fume hood) serving the classroom. Devices used to interrupt the gas and water valves shall be normally closed devices, and devices used to interrupt the electrical power shall fail open. The emergency switch shall be highly visible, have a keyed reset and be readily accessible to the teacher but not easily reached by students. For gas systems, gas service remains off at all times unless activated by a 0-6 hour timed switch. Timed switch shall require a key access.
- Provide a permanent means of 2-way communication between each lab / classroom and the school administration staff.

General Facilities Notes

- The use of self-contained burner with replaceable fuel canister or electric smooth-top hotplates as heat sources is recommended. Where electric hotplates are anticipated, provide a sufficient number of receptacles and a sufficient number of properly sized circuits to service increased load due to hot plates. If gas is used, use gas jet safety caps on the gas jets to prevent gas leakage and vandalism.
- All storage shelves that hold chemicals (in any type of container) require ½" minimum wooden lips on the front of the shelves and shelf supports must be non-metal.
- Every school must have emergency plans in place for fire, tornado / bad weather, accidents.

Course title: Elementary Science (k-5)

North Carolina graduation requirements include elementary grade sciences taught as laboratory sciences.

TYPES OF INSTRUCTION

Inquiry-based; hands-on laboratory; lecture / demonstration; collaborative learning

TYPICAL ACTIVITIES

Classroom instruction; laboratory investigations; individual and small-group projects; greenhouse and animal observation; utilization of technology, including computers and calculators

SHARED SPACE OPTIONS

Pre-kindergarten through grade 3 science should be integrated with other subjects and investigations. The self-contained classroom will require adequate table and floor space where investigations can be conducted easily. Sinks and counters at appropriate student height are needed, so frequent hand washing and clean-up can be accomplished with minimum assistance.

Grade 4 and 5 classrooms should have greater capacity to accommodate science investigations. Provision should be made to integrate science into classroom projects by providing sinks, flat surfaces, electricity, video connections, and overnight storage of projects in the classroom.

SPACE RECOMMENDATIONS

1. A minimum of 40 square feet per student is desirable for a stand-alone laboratory — 960 square feet for a class of 24 students.*
2. A minimum of 45 square feet per student is desirable for a multiple-use classroom where science is taught, or 1,080 square feet for a class of 24 students.*
3. An additional 10 square feet of space per student (240 square feet of space for 24 students) is desirable for preparation space for the teacher and storage space. This may be remote and may be shared with other multiple-use classrooms.
4. An additional 15 square feet of space is needed for each computer station and approximately 20 additional square feet to accommodate each student with disabilities.

*The National Science Teachers Association recommends a maximum class size of 24.

PECULIAR NEEDS

1. Six computer stations linked to the Internet with data logging capability
2. Greenhouse center (small attached windows with shelves facing the sun) or optional separate greenhouse.
3. Dry erase boards
4. Overhead projection screen
5. Access to outdoor activity center or garden
6. Safety equipment for every science classroom and/or laboratory:
 - Fire blanket
 - Fire extinguisher (ABC)
 - Spill control center
 - Safety shield
 - Goggles and goggle sanitizer
 - Heat-resistant gloves
 - Aprons
 - Eye wash
 - Broken glass disposal container
7. Teacher use only: self-contained burner with replaceable fuel canister or electric smooth top hot plate as heat source.

FURNISHINGS AND EQUIPMENT

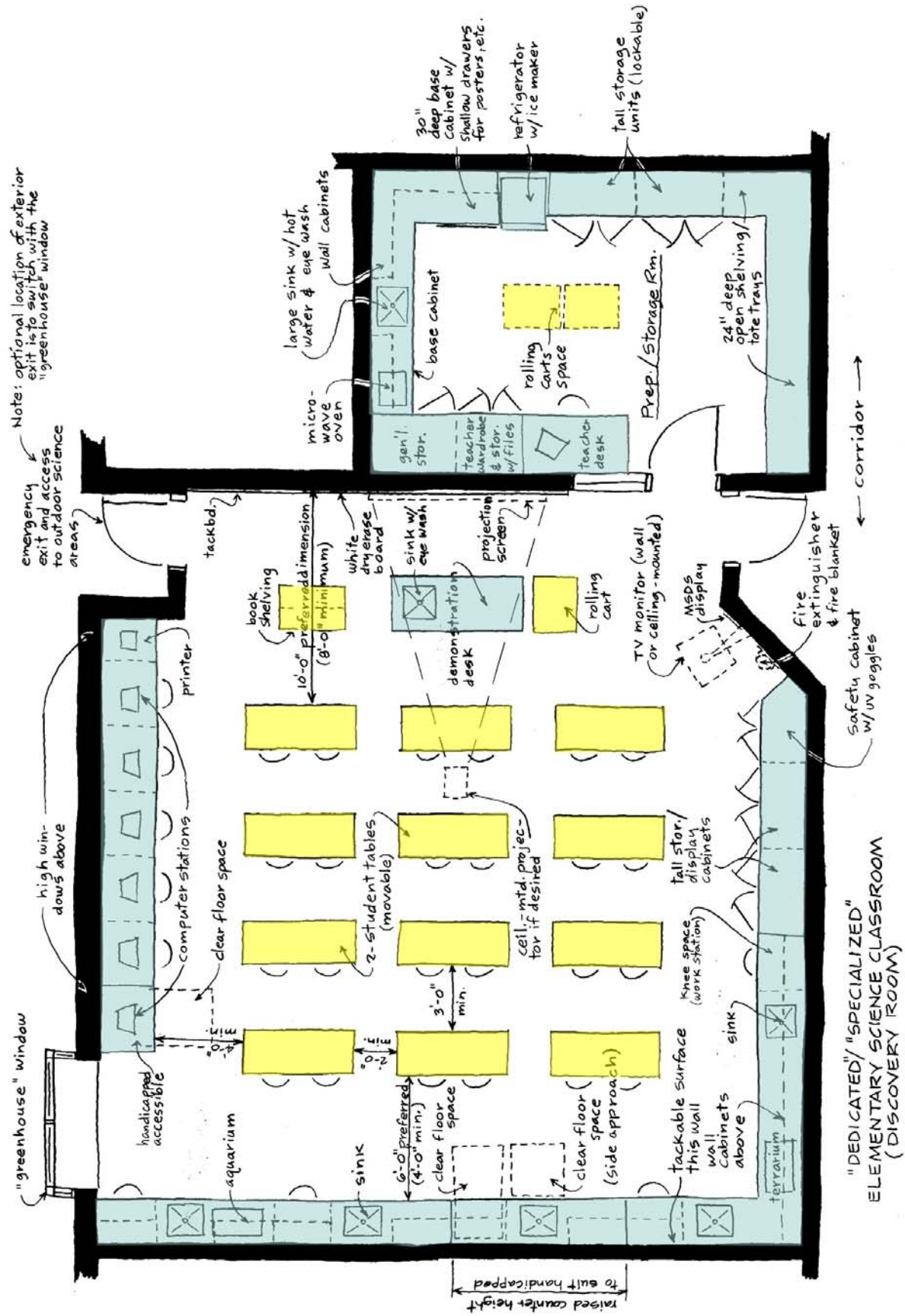
1. Typical Furniture
 - Flat-topped moveable tables of appropriate size for students.
2. Typical Casework
 - A. Base cabinets with sink (hot and cold water supply) mounted at student height, with an eye wash and goose neck style faucet.
 - B. Additional “wet areas”
 - C. Storage cabinets with adjustable shelves over base cabinets
 - D. Full height storage cabinets
 - E. Display cabinets
 - F. Tote tray storage
 - G. Counters at student height along two walls with additional work and preparation space
 - H. Plastic laminate counter tops.
3. Typical Equipment
 - A. Safety equipment See #6, “Peculiar Needs” on this page.
 - B. Microscopes and typical laboratory equipment
 - C. Aquarium
 - D. Terrarium
 - E. Window greenhouse

SPECIAL NOTES

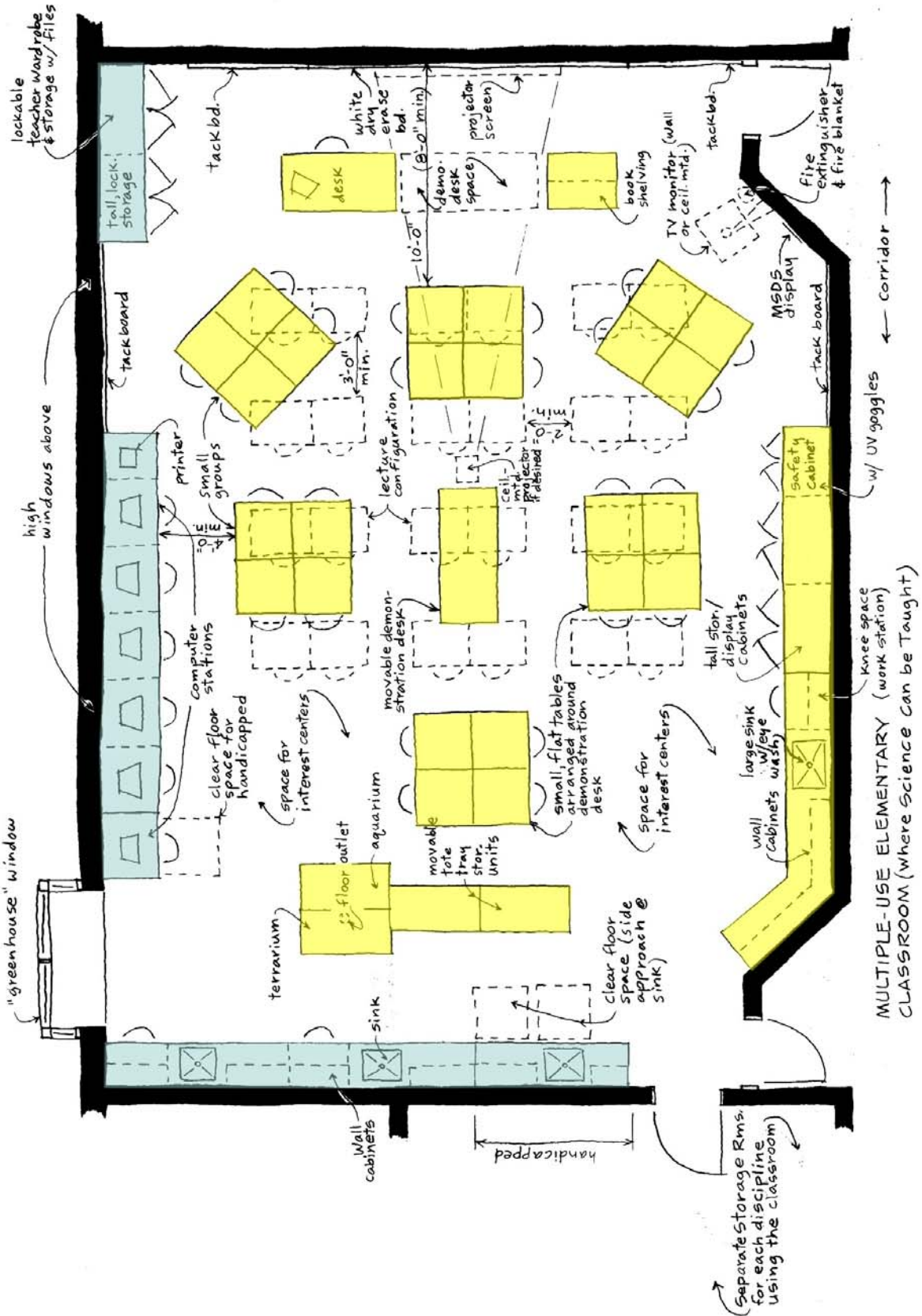
1. Telephone for teacher
2. Manually controlled emergency exhaust system
3. Manually controlled emergency shut-off of gas, water and electrical power.



Heat sources are for teacher use only.



"DEDICATED"/ "SPECIALIZED" ELEMENTARY SCIENCE CLASSROOM (DISCOVERY ROOM)



Course title: Middle level Science (6-8)

North Carolina graduation requirements include middle grades sciences taught as laboratory sciences.

TYPES OF INSTRUCTION

Inquiry-based; hands-on laboratory; lecture / demonstration; collaborative learning

TYPICAL ACTIVITIES

Classroom instruction; laboratory investigations; individual and small-group projects; observation of organisms; utilization of technology, including computers, Calculator-based labs (CBL) and probe ware

PROGRAM LOCATIONS AND RELATIONSHIPS

Should be located near other science laboratories, storage areas, and the teacher who serves as the Chemical Hygiene Officer (CHO). Grade level teams have to be scheduled by the CHO for use of the lab.

SHARED SPACE OPTIONS

The middle school offers opportunities for integrating other subjects with science by grouping several facilities, such as mathematics and applied sciences, with related subjects.

SPACE REQUIREMENTS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Science room: 1000 sq. ft.
2. Preparation & storage room: 250 sq. ft.
3. One larger preparation & storage room may be provided for each grade level.

PECULIAR NEEDS FOR MIDDLE SCHOOL (GRADES 6-8) [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

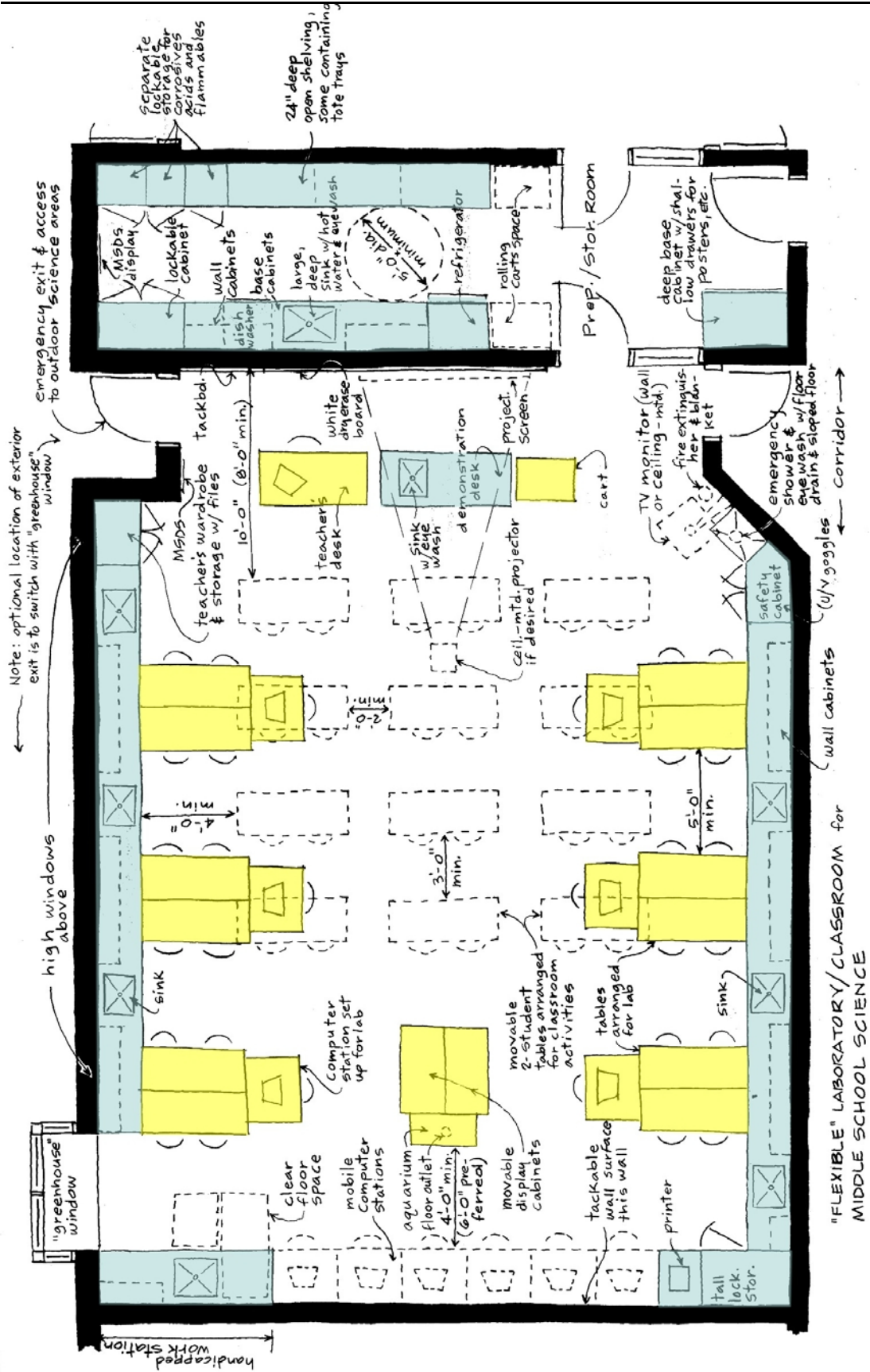
1. Six computer stations linked to the Internet, with data-logging capability
2. Greenhouse center (small attached windows with shelves facing the sun) or optional separate greenhouse
3. Teacher preparation / storage area, with properly vented lockable chemical storage cabinets
4. Self-contained burner with replaceable fuel canister or electric smooth-top hotplates as heat sources
5. Dry erase boards
6. Overhead projection screen
7. Safety Equipment for every middle school science classroom and / or laboratory:
 - Acid, flammable, corrosive cabinets (located in the storage / preparation room or chemical storage room)
 - Fire blanket
 - Chemical-and flame-resistant aprons / lab coats
 - Fire extinguisher (ABC)
 - Spill control center
 - Safety shield
 - Goggles and goggle sanitizer
 - Heat and acid-resistant gloves
 - Safety / chemical inventory software
 - Broken glass disposal container
 - MSDSs for every chemical, including kitchen type
 - Eyewash, safety shower

FURNISHINGS AND EQUIPMENT [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Typical Furniture
 - A. Work bench-type tables & chairs
 - B. Teacher desk and file cabinets
 - C. Teacher demonstration table with a sink (hot and cold water supply) and goose neck style faucet.
 - D. Acid-resistant tops
2. Typical Casework
 - A. Base cabinets with sinks (cold water supply) (1 sink per 4 students) and goose neck style faucet.
 - B. Storage cabinets with adjustable shelves over base cabinets
 - C. Full height storage cabinets
 - D. Display cabinets
 - E. Acid Resistant tops

SPECIAL NOTES [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Telephone for teacher.
2. Manually controlled emergency exhaust system.
3. Continuously operating exhaust system in preparation rooms and chemical storage rooms.
4. Manually controlled emergency shut-off of gas, water, and electrical power.
5. Acid resistant waste piping and dilution / neutralization devices.



"FLEXIBLE" LABORATORY/CLASSROOM for MIDDLE SCHOOL SCIENCE

HIGH SCHOOL SCIENCE

Course title: Biology (9-12)

North Carolina graduation requirements include a biology course taught as a laboratory science.

TYPES OF INSTRUCTION

Inquiry-based; hands-on laboratory; lecture / demonstration; collaborative learning

TYPICAL ACTIVITIES

Classroom instruction; laboratory investigations; individual and small-group projects; observations of organisms; utilization of technology, including Calculator Based Labs (CLBs) and probeware

MAXIMUM RECOMMENDED CLASS SIZE: 24 (per National Science Teachers Association)

PROGRAM LOCATIONS AND RELATIONSHIPS

Should be located near other science laboratories and chemical storage areas

SHARED SPACE OPTIONS (Additional Safety Features may be required for other use)

Other science laboratories:

- A. Chemistry
- B. Earth / Environmental Science

SPACE REQUIREMENTS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Biology lab: 1200 sq. ft.
2. Preparation & Storage room: 250 sq. ft. (may be shared with an adjacent Biology classroom)

PECULIAR NEEDS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Six computer stations linked to the Internet
2. Greenhouse center (small attached windows with shelves facing the sun) or optional separate greenhouse.
3. Teacher preparation / storage area with properly vented lockable chemical storage cabinets.
4. Self-contained burner with replaceable fuel canister or electric smooth-top hotplates as heat sources
5. Safety equipment: [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]
 - Acid, flammable, and corrosive cabinets (located in storage / preparation room or chemical storage room)
 - Fire blanket
 - Fire extinguisher ABC
 - Spill control center
 - Safety shield
 - Goggles and goggle sanitizer
 - Heat- and acid-resistant gloves
 - Chemical- and flame-resistant aprons / lab coats
 - Broken glass disposal container
 - MSDS for all chemicals
 - Safety / chemical inventory software
 - Laboratory-grade dishwasher
 - Laboratory, spark-free refrigerator (regular refrigerator if explosion-proof one available in chemistry room)
 - Eyewash, safety shower
 - Corrosive cabinets (no metal)
 - Fire extinguisher (ABC)
 - Chemical splash goggles and goggle sanitizer
 - Non-latex gloves

FURNISHINGS AND EQUIPMENT [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Typical Furniture

- A. Student laboratory tables with deep sinks, flat top work areas and goose neck style faucets.
- B. Teacher desk and file cabinets
- C. Teacher demonstration table with a sink (hot and cold water supply) and goose neck style faucets.
- D. Work bench type tables and chairs
- E. Acid resistant tops & sinks.

2. Typical Casework

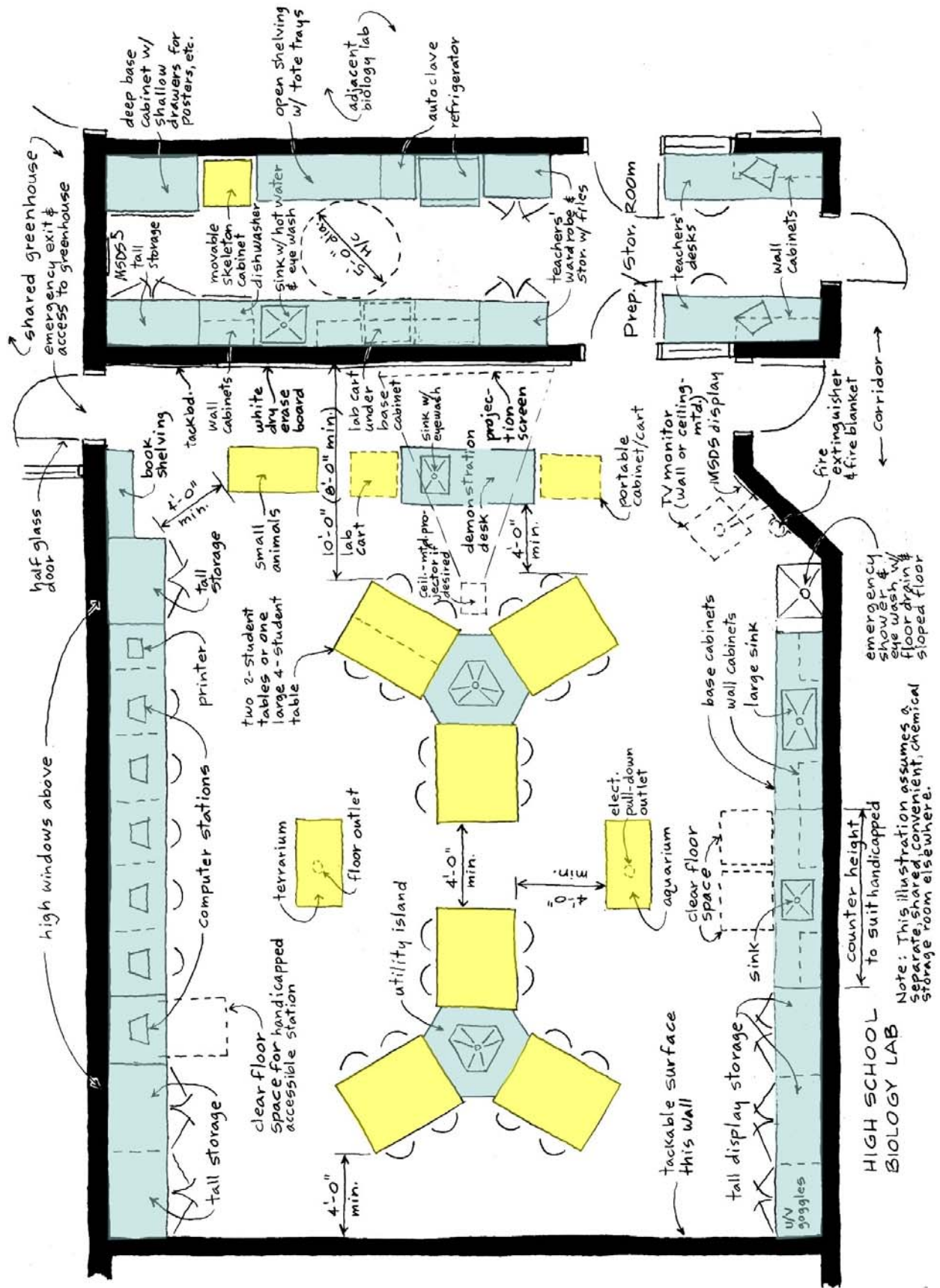
- A. Base cabinet with sink (acid resistant)
- B. Storage cabinets with adjustable shelves over base cabinets
- C. Full-height storage cabinets

3. Typical Equipment

- A. Safety equipment (see item #5 above)
- B. Microscopes and typical laboratory equipment
- C. Aquarium
- D. Projection microscope
- E. Non-mercury thermometer

SPECIAL NOTES [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

- 1. Telephone for teacher
- 2. Manually controlled emergency exhaust system.
- 3. Continuously operating exhaust system in preparation rooms and chemical storage rooms.
- 4. Manually controlled emergency shut-off of gas, water and electrical power.
- 5. Acid resistant waste piping and dilution / neutralization devices.



Course title: Chemistry (9-12)

North Carolina graduation requirements include a physical science (chemistry) course taught as a laboratory science.

TYPES OF INSTRUCTION

Inquiry-based; hands-on; lecture / demonstration; collaborative learning

TYPICAL ACTIVITIES

Classroom instruction; laboratory investigations; individual and small-group projects; chemistry investigations; utilization of technology, including computers, Calculator-based labs (CBL), and probeware

MAXIMUM RECOMMENDED CLASS SIZE: 24 (per National Science Teachers Association)

PROGRAM LOCATIONS AND RELATIONSHIPS

Should be located near other science laboratories and chemical storage areas

SHARED SPACED OPTIONS

1. Other science laboratories: Biology
Physics
Physical Science
Earth / Environmental Science

SPACE REQUIREMENTS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Chemistry Lab / Classroom combination: 1500 sq. ft.
2. Preparation & Storage Room: 250 sq. ft.
3. Chemical Storage Room: 80 sq. ft. Can be a part of the preparation room square footage

PECULIAR NEEDS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Six computer stations linked to the Internet, with data logging capability
2. Teacher preparation / storage area (with properly vented lockable chemical storage cabinets, unless located in separate chemical storage room).
3. Chemical fume hood
4. Self-contained burner with replacement fuel canister or electric smooth-top hotplates as heat sources
5. Dry-erase boards
6. Overhead projection screen
7. Safety equipment:
 - Acid, flammable, corrosive cabinets (located in storage / preparation room or chemical storage room)
 - Fire blanket
 - Fire extinguisher, ABC, sand for metal fires
 - Spill control center
 - Safety shield
 - Heat- and acid-resistant gloves
 - Goggles and goggle sanitizer
 - Chemical-and flame-resistant aprons / lab coats
 - Safety / chemical inventory software
 - Broken glass disposal container
 - NFPA signs

PECULIAR NEEDS (cont.) [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

- MSDSs for all chemicals
- Laboratory-grade dishwasher
- Laboratory, spark-free refrigerator
- Eyewash, safety showers
- Corrosive cabinets (no metal)
- Non-latex gloves
- Chemical splash goggles and goggle sanitizer

FURNISHINGS AND EQUIPMENT [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Typical Furniture
 - A. Student laboratory tables with deep sinks, flat top work areas (acid resistant) and goose neck style faucets.
 - B. Teacher desk and file cabinets
 - C. Teacher demonstration table with a sink (hot and cold water supply) (acid resistant) and goose neck style faucets.
 - D. Work bench-type tables (for safety sake work surface should be standing height ; no stools or chairs)
 - E. Acid resistant tops & sinks.
2. Typical Casework
 - A. Base cabinets with sinks (acid resistant)
 - B. Storage cabinets with adjustable shelves over base cabinets
 - C. Full-height storage cabinets
 - D. Display cabinets
3. Typical Equipment
 - A. Safety equipment (see above)
 - B. Typical laboratory equipment
 - C. Electronic and analytical balances
 - D. Computer and calculator interface data logging units
 - E. Non-mercury barometers
 - F. Non-mercury thermometer

SPECIAL NOTES [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Telephone for teacher
2. Manually controlled emergency exhaust system.
3. Continuously operating exhaust system in preparation rooms and chemical storage rooms
4. Manually controlled emergency shut-off of gas, water and electric power.
5. Acid resistant waste piping and dilution / neutralization devices.

Course title: Earth / Environmental Science (9-12)

North Carolina graduation requirements include an earth / environmental science course taught as a laboratory science.

TYPES OF INSTRUCTION

Inquiry-based; hands-on; lecture / demonstration; collaborative learning

TYPICAL ACTIVITIES

Classroom instruction; laboratory investigations; individual and small-group projects; and geology, meteorology, astronomy, oceanography experimentation and observation; utilization of technology, including computers, CBLs, and probeware.

MAXIMUM RECOMMENDED CLASS SIZE: 24 (per National Science Teachers Association)

PROGRAM LOCATIONS AND RELATIONSHIPS

Should be located near other science laboratories and chemical storage areas.

SHARED SPACE OPTIONS (Additional safety features may be required for other use)

Other science laboratories:

Biology

Physics

Physical Science

Chemistry

SPACE REQUIREMENTS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Earth / Environmental Science Room: 1400 sq. ft.
2. Preparation & Storage Room: 250 sq. ft. (can be shared)
3. Chemical Storage Room: 80 sq. ft. (can be shared)

PECULIAR NEEDS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Six computer stations linked to the Internet, with data logging capability
2. Teacher preparation / storage area, with properly vented lockable chemical storage cabinets.
3. Fume hood when laboratory / classroom is also used for chemistry.
4. Self-contained burner with replacement canisters or electric smooth top hotplate heat surfaces
5. Dry-erase boards
6. Overhead projection screen
7. Access to weather instruments
8. Safety equipment
 - Acid, flammable, corrosive cabinets (located in storage / preparation room or chemical storage room)
 - Fire blanket
 - First Aid Kit
 - Fire extinguisher, ABC, sand for metal fires
 - Spill control center
 - Safety shield
 - Heat- and acid-resistant gloves
 - Goggles and goggle sanitizer
 - Chemical-and flame-resistant aprons / lab coats
 - Safety / chemical inventory software
 - Broken glass disposal container
 - NFPA signs

- MSDSs for all chemicals
- Laboratory-grade dishwasher
- Laboratory, spark-free refrigerator (if lab is to be used for chemistry, otherwise, regular refrigerator)
- Eyewash, safety shower
- Corrosive cabinets (no metal)
- Non-latex gloves
- Chemical splash goggles and goggle sanitizer

FURNISHINGS AND EQUIPMENT [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Typical Furniture

- A. Student laboratory tables with deep sinks, flattop work areas and goose neck style faucets.
- B. Teacher desk and file cabinets
- C. Teacher demonstration table with a sink (hot and cold water supply) and goose neck style faucets.
- D. Work bench-type tables and chairs
- E. Acid resistant tops & sinks.

2. Typical Casework

- A. Base cabinets with sinks
- B. Storage cabinets with adjustable shelves over base cabinets
- C. Full-height storage cabinets
- D. Display cabinets
- E. Acid Resistant tops & sinks

3. Typical Equipment

- A. Safety equipment (see #8 above)
- B. Stereo microscopes
- C. Astronomical telescope
- D. Typical laboratory equipment
- E. Computer and calculator interface data logging units
- F. Non-mercury instruments

SPECIAL NOTES [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

- 1. Telephone for teacher
- 2. Manually controlled emergency exhaust system
- 3. Continuously operating exhaust system in preparation rooms and chemical storage room
- 4. Manually controlled emergency shut-off of gas, water, and electrical power.
- 5. Acid resistant waste piping and dilution / neutralization devices.

SAMPLE PLAN

Similar to biology

Course title: Physical Science (9-12)

North Carolina graduation requirements include a physical science course taught as a laboratory science.

TYPES OF INSTRUCTION

Inquiry-based, hands-on; lecture / demonstration; collaborative learning

TYPICAL ACTIVITIES

Classroom instruction; laboratory investigations; individual and small-group projects; chemistry and physics experiments; utilization of technology, including computers, Calculator-based labs (CBL), and graphing calculators

MAXIMUM RECOMMENDED CLASS SIZE: 24 (per National Science Teachers Association)

PROGRAM LOCATIONS AND RELATIONSHIPS

Should be located near other science laboratories and chemical storage areas.

SHARED SPACE OPTIONS

1. Other science laboratories:
 - Chemistry
 - Earth / Environmental science
 - Physics

SPACE REQUIREMENTS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Physical Science Room: 1200 sq. ft.
2. Preparation & Storage Room: 250 sq. ft. (can be shared)
3. Chemical Storage Room: 80 sq. ft. (can be shared and a part of the preparation room square footage)

PECULIAR NEEDS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Six computer stations linked to the Internet, with data logging capability
2. Power supply units for electricity experiments
3. Teacher preparation / storage area with properly vented lockable chemical storage cabinets.
4. Fume hood when laboratory / classroom is also used for chemistry
5. Self-Contained burner with replaceable fuel canister or electric smooth top hotplate heat sources.
6. Safety equipment:
 - Acid, flammable, corrosive cabinets (located in storage / preparation room, or chemical storage room)
 - Fire blanket
 - Fire extinguisher, ABC, sand for metal fires
 - Spill control center
 - Safety shield
 - Heat- and acid-resistant gloves
 - Goggles and goggle sanitizer
 - Chemical-and flame-resistant aprons / lab coats
 - Safety / chemical inventory software
 - Broken glass disposal container
 - NFPA signs
 - MSDSs for all chemicals
 - Laboratory-grade dishwasher
 - Laboratory, spark-free refrigerator (if lab is to be used for chemistry, otherwise, regular refrigerator)
 - Eyewash, safety shower
 - Corrosive cabinets (no metal)
 - Non-latex gloves
 - Chemical splash goggles and goggle sanitizer

FURNISHINGS AND EQUIPMENT [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Typical Furniture

- A. Student laboratory tables with deep sinks, flat top work areas and goose neck style faucets.
- B. Teacher desk and file cabinets
- C. Teacher demonstration table with a sink (hot and cold water supply) and goose neck style faucets.
- D. Work bench-type tables and chairs
- E. Acid resistant tops & sinks.

2. Typical Casework

- A. Base cabinet with sinks
- B. Storage cabinets with adjustable shelves over base cabinets
- C. Full-height storage cabinets
- D. Acid-resistant type.

3. Typical Equipment:

- A. Safety equipment (see #6 above)
- B. Typical laboratory equipment
- C. Student and teacher power supplies
- D. Computer and calculator interface data logging units.

SPECIAL NOTES [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

- 1. Telephone for teacher
- 2. Manually controlled emergency exhaust system.
- 3. Continuously operating exhaust system in preparation room and chemical storage room.
- 4. Manually controlled emergency shut-off of gas, water, and electric power.
- 5. Acid resistant waste piping and dilution / neutralization devices.

SAMPLE PLAN

Similar to physics

Course title: Physics (9-12)

North Carolina graduation requirements include a physical science (physics) course taught as a laboratory science.

TYPES OF INSTRUCTION

Inquiry-based; hands-on; lecture / demonstration; collaborative learning

TYPICAL ACTIVITIES

Classroom instruction; laboratory investigations; individual and small-group projects and physics experiments; utilization of technology, including computers, Calculator-based labs (CBL), and graphing calculators

MAXIMUM RECOMMENDED CLASS SIZE: 24 (per National Science Teachers Association)

PROGRAM LOCATIONS AND RELATIONSHIPS

Should be located near other science laboratories and chemical storage areas

SHARED SPACE OPTIONS (Additional Safety features may be required for other use)

1. Other science laboratories:
 - Chemistry
 - Earth / Environmental science
 - Physical science

SPACE REQUIREMENTS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Physics Room: 1200 sq. ft.
2. Preparation & Storage Room: 250 sq. ft.

PECULIAR NEEDS [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

Note that if the physics lab is to be used for other subjects (shared use) the following list may need to be revised to suit the more stringent activities involved.

1. Six computer stations linked to the Internet, with data logging capability
2. Power supply units for electricity experiments
3. Fume hood when laboratory / classroom is also used for chemistry
4. Self-contained burner with replaceable fuel canister or electric hotplate heat sources.
5. Safety equipment :
 - Fire blanket
 - Fire extinguisher, ABC, sand for metal fires
 - First Aid Kit
 - Spill control center
 - Safety shield

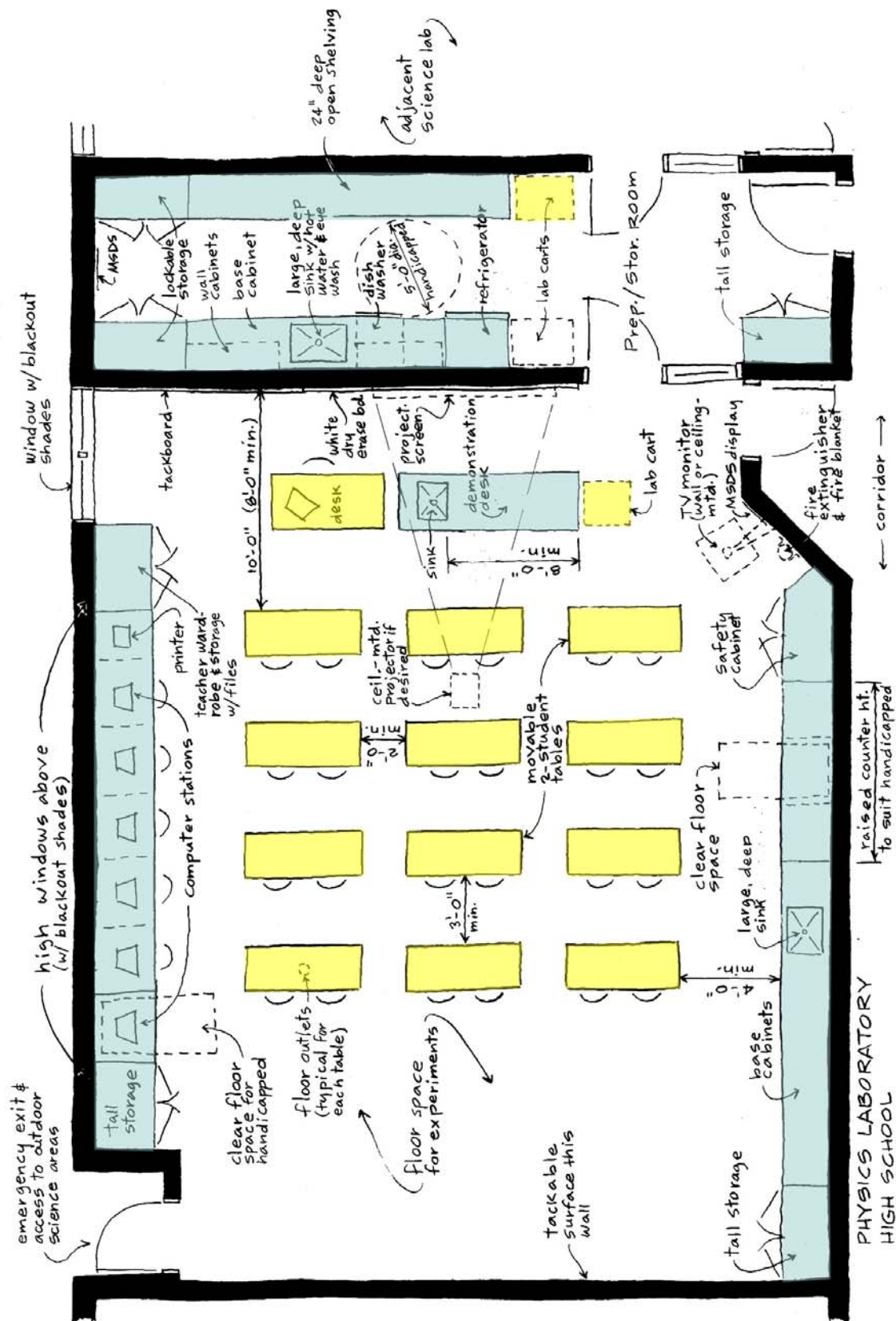
- Heat- and acid-resistant gloves
 - Goggles and goggle sanitizer
 - Chemical-and flame-resistant aprons / lab coats
 - Safety / chemical inventory software
 - Broken glass disposal container
 - NFPA signs
 - MSDSs for all chemicals
 - Eyewash, safety shower (If lab is to be used for chemistry)
 - Corrosive cabinets (no metal)
 - Non-latex gloves
 - Chemical splash goggles and goggle sanitizer
 - Room darkening shades for light investigation
7. Preparation / storage room
- Separate cabinets for acid, flammable, corrosive chemicals (If lab is to be used for chemistry)
 - Safety / chemical inventory software
 - MSDSs for all chemicals
 - Laboratory-grade dishwasher (if lab is to be used for chemistry)
 - Laboratory, spark-free refrigerator (if lab is to be used for chemistry, otherwise regular refrigerator)
 - Eyewash (if chemicals are used)

FURNISHINGS AND EQUIPMENT [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Typical Furniture
- A. Student laboratory tables with at least one deep sink, flat-top work areas and goose neck style faucets.
 - B. Teacher desk and file cabinets
 - C. Teacher demonstration table (8') with a sink (hot and cold water supply) and goose neck style faucets.
 - D. Work bench-type tables and chairs (acid resistant)
 - E. Acid resistant tops & sinks.
2. Typical Casework
- A. Base cabinet with sinks (acid resistant)
 - B. Storage cabinets with adjustable shelves over base cabinets
 - C. Full-height storage cabinets
3. Typical Equipment
- A. Safety equipment (see above)
 - B. Typical laboratory equipment
 - C. Student power supplies for electricity experiments
 - D. Computer and calculator interface data logging units

SPECIAL NOTES [NOTE: See “Check-list For Science Safety Requirements” for required items in the back of this publication. (Appendix “A”)]

1. Telephone for teacher
2. Manually controlled emergency exhaust system
3. Continuously operating exhaust system for preparation rooms and chemical storage rooms
4. Manually controlled emergency shut-off of gas, water, and electrical power.



APPENDIX “A”

CHECK-LIST FOR SCIENCE SAFETY REQUIREMENTS

(Required Minimums for Approval by the
N.C. Board of Education)

CHECKLIST FOR SCIENCE SAFETY REQUIREMENTS

Middle and High School Science Safety Standards.

The NC State Board of Education shall approve public school plans for science facilities in middle schools and high schools to ensure safety. In addition to the following NCSBE standards, the plans shall comply with all federal, state and local requirements (e.g. Occupational Safety and Health Administration Standards, Americans with Disabilities Act, the North Carolina State Building Code, etc.). Approval of the plans is required prior to occupancy of the science classrooms. The local education agency (LEA) is responsible for training staff and maintaining the systems and equipment to ensure safety.

- (a) LEAs shall submit scaled floor plans showing that the proposed science facilities, including the required and proposed equipment and furniture, provide for adequate circulation and teaching space and are safe for instruction. Facilities of the following gross sizes, as measured from the inside face of walls, shall be presumed to meet these requirements:
 - (1) Middle School:
 - (A) Science room shall be at least 1000 square feet;
 - (B) Preparation rooms shall be at least 250 square feet;
 - (C) One larger preparation room may be provided for each grade level.
 - (2) High School:
 - (A) Physical Science room shall be at least 1200 square feet;
 - (B) Biology room shall be at least 1200 square feet;
 - (C) Physics room shall be at least 1200 square feet;
 - (D) Earth Science room shall be at least 1400 square feet;
 - (E) Chemistry room shall be at least 1500 square feet;
 - (F) Multipurpose Science room shall be at least 1500 square feet;
 - (G) Preparation room shall be at least 250 square feet;
 - (H) Chemical Storage Room shall be at least 80 square feet.
- (b) General Lab / Classroom:
 - (1) Provide student lab furniture/built-ins with acid-resistant tops and sinks to suit the curriculum / subject area. If work stations require sinks, the number of sinks shall be based on one sink per 4 students in each lab.
 - (2) Provide a teacher demonstration table in each lab and each science classroom.
 - (3) Where wall cabinets occur, they shall be located above base cabinets.
 - (4) If wall cabinets are located above a sink cabinet, the bottom of the wall cabinet must be at least 5 feet above finished floor.

- (5) Dry erase marker boards shall be provided. Chalk boards are not permitted.
- (6) Storage for students' coats and book bags in the form of lockers, open shelves with hooks or similar device shall be provided.
- (7) A manually controlled emergency exhaust system, exhausting a minimum of six air changes per hour, for each science room not dedicated to physics shall be provided.
- (8) Chemistry labs shall include work surfaces at standing height (42 inches above finished floor, except as required by the ADA.).
- * (9) Provide space between furniture, built-ins, and other objects to allow safe movement for teacher and students. Handicapped accessibility route requirements mandate a minimum of 36 inches unless a protrusion width of 24 inches or less occurs, when 32 inches is allowed.
- * (10) Provide at least one student lab work station per lab as required by the Americans with Disabilities Act (ADA).

(c) Preparation Room:

- (1) A preparation room within at least 150 ft. of Middle School science rooms shall be provided. High School preparation rooms shall be adjacent to the science rooms. High School Preparation rooms may be shared by two labs. Middle School Preparation rooms may be shared by four labs.
- (2) Doors shall be equipped with keyed locks.
- (3) Provide lip on shelf edges at least ½" in height;
- (4) If hazardous chemicals are stored in Preparation rooms, they shall be in commercial, specially designed, ventilated as required, locked hazardous chemical storage cabinets. Separate cabinets shall be labeled that contain acids, flammables and corrosives.
- (5) A continuously operating exhaust system, exhausting a minimum of six air changes per hour shall be provided.
- (6) A dishwasher, where glassware is used, that is labeled "laboratory grade" shall be provided.
- (7) Space for a refrigerator (spark-free when used for chemistry, otherwise regular refrigerator) shall be provided.
- (8) Warm water within the range specified by NC State Building Code shall be provided to the sink.

(d) Chemical Storage Room:

- (1) Access to the chemical storage room is preferred to be through the Preparation Room if adjacent, or a single chemical storage room may be provided near the science areas.
- (2) The door shall be equipped with a keyed lock and shall swing outward. Door hardware shall always allow passage from inside room.
- (3) Provide commercially available, specially designed ventilated as mfr. recommended, locked, hazardous chemical storage cabinets and labeled as such. Provide separate chemical storage units each for acids, flammables, and corrosives.

- (4) Shelves and cabinets:
 - (A) Shall be mechanically attached with bolts, screws or other devices to wall;
 - (B) Use corrosive resistant materials;
 - (C) Shelves shall be a maximum of 12-inch deep;
 - (D) Provide lip on shelf edges at least ½" in height;
 - (E) Provide positive cabinet door latches that will withstand a seismic event. Latches must be specially designed and labeled to be earthquake resistant, relying on a mechanical type securement method as opposed to a magnetic one.
- (5) Provide continuously operating exhaust system, exhausting a minimum of six air changes per hour.
- (6) Chemical Storage Room light switch shall be located outside the room and no receptacles shall be located inside of room.
- *(7) MSDS (material safety data sheets): a space shall be provided where these sheets will be displayed inside and outside this room, adjacent the door.

(f) Safety Equipment / Systems:

- (1) Fume Hoods:
 - (A) Shall be required for high school chemistry;
 - (B) No ductless hoods or hoods requiring internal filtration will be allowed;
 - (C) Each hood shall be individually exhausted directly to the outside, a minimum of 20 feet from air intakes or building openings. All ductwork shall be stainless steel;
 - (D) Hood shall be located where effectiveness will not be jeopardized due to turbulent air flow;
 - (E) Makeup air that is equivalent to exhaust air volume shall be provided;
 - (F) Each hood shall have an air flow monitoring device and an alarm;
 - (G) Fans shall be located outside the building envelope.
 - *(H) Provide spark-proof exhaust fans.
- (2) Eyewash and safety showers
 - (A) A floor drain shall be provided at each emergency shower.
 - (B) Eyewash and safety showers shall be provided in each science room not dedicated to physics.
 - (C) Provide an eyewash station in the preparation room;

- * (D) A minimum of one eyewash and one shower shall be handicap accessible;
- * (E) Each eyewash and safety shower shall be supplied with luke warm water as required in section 411 of the North Carolina State Plumbing Code;

- * (3) Provide a fire blanket and sand for metal fires in addition to building code required ABC fire extinguishers
- (4) Provide safety cabinet(s) for storage of goggles, heat and acid resistant gloves and chemical resistant aprons, etc.
- (5) All chemical storage cabinets shall be vented or not according to the cabinet manufacturers' recommendations.
- (6) If a central hazardous chemical dilution or neutralization tank is used, it shall be located outside of the building and a minimum of twenty feet away from building openings.
- (7) Provide a single emergency shut-off switch in each lab / classroom that will close valves in the gas, water source serving each particular lab / classroom and interrupt all power not serving fume hoods, exhaust systems or lighting.
- (8) Provide a permanent means of 2-way communication between each lab / classroom and the school administration staff.
- * (9) All plumbing fixtures located in the lab or preparation room where hazardous chemicals are used, shall drain through a local dilution or neutralization device or drain into a central acid waste system. Fixtures and piping upstream of dilution or neutralization devices shall be acid resistant.
- * (10) Ground Fault Interruption (GFI) protection for all outlets in the laboratory and preparation rooms shall be provided.

* (g) Exits:

- (1) If net square footage of a science classroom/lab is 1000 sq. ft. or more it shall have at least 2 exits with doors swinging in direction of exit egress. Net area is calculated by subtracting fixed equipment and fixed furniture from the total area.
- (2) Un-sprinklered buildings: emergency egress window is required (unless a door directly to exterior is provided).
 - (A) Window Requirements:
 - (i) Minimum width of opening shall be 20 inches;
 - (ii) Minimum height of opening shall be 24 inches;
 - (iii) Minimum clear opening shall be 5 square ft. for on-grade floor and 5.7 square ft. for above-grade floors;

- (iv) Height above floor to bottom of clear opening shall be a maximum of 32 inches for grades 5 and under and a maximum of 44 inches for grades 6 and above;
 - (v) Operation shall be from the inside and not require keys or tools.
- (3) Windows are recommended in science classrooms, but not required. All windowless classrooms shall contain the following specifications:
 - (A) Un-sprinklered building requirements:
 - (i) Second exit through another classroom (cannot be a storage or preparation room) directly to a separate smoke compartment with access to an exit in the other direction;
 - (ii) Compartments are separated by smoke barriers having a 1-hour fire rating with self closing or automatic closing doors;
 - (iii) Length of path shall not exceed 150 feet;
 - (iv) Each communicating door shall be identified;
 - (v) Each communicating door shall be non-locking.
 - (B) Provide clear egress pathways within the lab or classroom.

* Items marked with asterisk are building code, ADA or other state or federal requirements.
Items not so marked are policy adopted by the State Board of Education March 2010

APPENDIX “B”

SAMPLE CHECK-LISTS (OPTIONAL)

(The following check-lists are based
on National Science Teachers Association
(NSTA) recommendations)

Note: These check lists can be useful as shown or as edited by LEA’s to assess their science facilities.

Sample Check-list for Elementary School Science*

Adapt and expand these guidelines to suit identified program requirements. Elementary Science rooms are not considered to be separate instructional spaces in North Carolina

Category	Guidelines	Good	Fair	Poor	Comments
Is there adequate floor space for the students to work safely?	Usually at least 850-1,000 square feet sufficient space between desks or tables.				
Four-foot aisles	Three-foot ADA minimum				
Is the space flexible? Rectangular room without alcoves.					
Is there room for open-floor investigations?	24-foot minimum room width				
	Moveable student tables				
	Movable Teacher's table				
Is there adequate space for the teacher?	Secure storage and desk				
	Space available to teacher during planning time				
Is the power supply adequate and safe?	Sufficient circuits and outlets to serve program and technology needs				
	Ground-fault interrupters in "Wet" areas				
Is lighting adequate?	Directed and diffused to avoid glare; 50-75 foot-candles (50@floor) per square foot at work surfaces				
Can lighting levels be controlled?	Room-darkening shades or blinds				
	Switches to reduce lighting by 50%				
Is there adequate and safe storage?	Secure teacher storage for materials				
	Space for lab and AV equipment				
Is there good infrastructure for communication?	Telephone or two-way intercom for emergencies				
	Network wiring for computers				
	Cable for Video communications				
Are there counters or tables for investigation?	Counters and tables age-appropriate heights per state building code and public schools facilities guidelines				
Is there a water supply suitable for investigation?	One sink at adult level, one or two additional at child level				
	High-arched swivel faucets and deep bowls				
Is there adequate space for displays?	Counter and floor space				
	Shelves and display cabinets				
	Easily reached tack boards				

Category	Guidelines	Good	Fair	Poor	Comments
Is there space to keep living organisms?	Grow lights				
	Shelves at windows for plants				
	Terrariums or aquariums				
Does the space meet ADA requirements?	At least one wheelchair-accessible counter and sink.				
	Accessible safety equipment, doors and passages. (per code)				
Are fire and safety measures in place?	Fire and safety equipment				
	Adequate fire exits				
	Adequate room ventilation				

** Adapted from NSTA Guide to School Science Facilities*

Sample Check-List for Middle School Science *

Adapt and expand these guidelines to suit identified program requirements

Category	Guidelines	Good	Fair	Poor	Comments
Is there adequate floor space for the students to work safely?	Usually at least 1,000-1,200 square feet				
	Sufficient space between desks or tables				
	Four-foot aisles				
Is there adequate space for the teacher?	Secure storage and desk				
	Not in shared classroom				
Is the power supply adequate and safe?	Sufficient circuits and outlets to serve program and technology needs				
	Sufficient outlets at lab stations				
	Ground-fault interrupters				
Is lighting adequate?	Directed and diffused to avoid glare				
	50-75 foot-candles per square foot at work surfaces; (50 @ floor)				
Can lighting levels be controlled?	Room-darkening shades or blinds				
	Switches to reduce lighting by 50%				
Is there adequate safe storage and a secure place for chemicals?	Separate lockable room or closet				
	Space for separation of incompatible chemicals				
	Adequate ventilation				
	Emergency lighting				
Is there good infrastructure for communication?	Telephone or two-way intercom for emergencies				
	Network wiring for computers				
	Cable for video				
Are there tables or counters for investigation?	TV or video projector				
	36" counter height for adults; 30"-36" for students				
	Tables 25"-30" for students				
Is there water supply suitable for investigation?	Moveable lab tables or fixed lab stations				
	3-6 student sinks				
	At least one large sink				
Is there adequate space for displays?	High-arched swivel faucets				
	Counter and floor space				
	Shelves and display cabinets				
	Easily reached tack boards				

Category	Guidelines	Good	Fair	Poor	Comments
Is there space to keep living organisms?	Greenhouse or window shelves for plants				
	Grow lights				
	Terrariums or aquariums				
	Note: This space may be shared with exploring biotechnology classes				
Is the preparation space adequate and secure?	Lockable storage and/or preparation space				
	Adequate ventilation				
Does the space meet ADA requirements?	At least one wheelchair accessible work station				
	Accessible safety equipment, doorways, passages (per code)				
Are fire and safety measures in place?	Fire and safety equipment				
	Adequate fire exits				
Are there exhaust fans to vent smoke and fumes?	Exhaust fans vented outside the building and maintain a slight negative pressure in the room				
Are a safety shower and eyewash provided where chemicals are used?	Dual eyewash within 25' of every workstation if hazardous chemicals are used				
	Combination shower / eyewash available				

* Adapted from NSTA Guide to School Science Facilities

Sample Check-List for High School Science *

Adapt and expand these guidelines to suit identified program requirements

Category	Guidelines	Good	Fair	Poor	Comments
Is there adequate floor space for the students to work safely?	Usually at least 45 square feet per student minimum for science labs				
	Additional space for classroom / lab combinations				
	Sufficient space between lab or work stations				
	Four-foot aisles				
Is there adequate space for the teacher?	Secure storage and desk				
	Not in shared classroom				
Is the power supply adequate and safe?	Sufficient circuits and outlets to serve program and technology needs				
	Sufficient outlets at lab stations				
	Ground-fault interrupters				
Is there adequate lighting?	Directed and diffused to avoid glare				
	50-75 foot-candles per square foot at work surfaces (50 @ floor)				
Can lighting levels be controlled?	Room-darkening shades or blinds				
	Switches to reduce lighting by 50%				
Is there adequate safe storage and a secure place for chemicals?	Separate lockable room or closet				
	Space for separation in incompatible chemicals				
	Adequate ventilation system				
Is there adequate and secure preparation space?	Lockable preparation room				
	At least 5 square feet per student				
	Adequate ventilation system				
Is there good infrastructure for communication?	Telephone or two-way intercom for emergencies				
	Network wiring for computers				
	Cable for video				
Are there tables or counters for investigation?	TV or video projector				
	36" counter height				
	Moveable lab tables or fixed lab stations				
	Epoxy resin work surfaces, where lab materials so indicate				

* Adapted from NSTA Guide to School Science Facilities

Category	Guidelines	Good	Fair	Poor	Comments
Is natural gas or other heat source available?	Natural gas or hotplates				
	One service per four students Safety shut-off in classroom				
Is there water supply suitable for investigation?	At least one sink per four students				
	Swivel and high-arched faucets				
	Deep bowls Hot (maximum 110 degrees) and cold water				
Is there adequate space for displays?	Shelves				
	Display cabinets				
Is there space for long-term investigation?	Separate holding space for projects				
	Space in classroom				
Does the space meet ADA requirements?	At least one wheelchair-accessible workstation				
	Accessible safety equipment, doorways, and passages (per code)				
Are fire and safety measures in place?	Fire and safety equipment				
	Adequate fire exits				
Is a fume hood provided where required?	Required if hazardous chemicals are used				
	Vented to outside of building				
Are a safety shower and eyewash provided?	Eyewash within 10 seconds of every workstation				
	Eyewash and shower available for simultaneous use. Combination unit may be applicable.				

Facilities Resources

NCDPI School Support Services

www.schoolclearinghouse.org

Science Laboratory Safety Manual, 2nd Edition www.sciencesafetyconsulting.com

Chemical Management System CD, 2nd Edition

www.sciencesafetyconsulting.com

NSTA Guide to School Science Facilities

www.nsta.org

Resources

Biehl, James T.; Motz, LaMoine L.; and West, Sandra S., *NSTA Guide to School Science Facilities*, 1999, National Science Teachers Association, Arlington, VA.

Designs for Science Facilities, 1971, Minnesota State Department of Education, St. Paul., MN.

Look of the Future: Report of the Governor's Committee on High School Science Laboratories for the 21st Century, 1992, State of Maryland, Baltimore, MD.

North Carolina Public School Facilities Guidelines, 2009, North Carolina Department of Public Instruction, Raleigh, NC.

North Carolina Standard course of Study and Introduction to the Competency-Based Curriculum, 2008, North Carolina Department of Public Instruction, Raleigh, NC.

Science Facilities Design Guidelines, 1994, Maryland State Department of Education, Baltimore, MD.

Regulatory References

SCIENCE AS LAB IN NORTH CAROLINA

GS 115C-81.4
GS 115C-521 (c1)
GS 116-96
GS 116-87

EYE PROTECTION (GOGGLES DEFINED; TYPE DEFINED; VISITORS TO LAB MUST WEAR)

GS 115C-166-168
ANSI Z87.1-168

EYE WASH (TEMPERATURE OF WATER; LOCATION; INSPECTION; TEN-SECOND RULE)

ISEA Z358.1-1990