CHAPTER 1

PREDESIGN

INTRODUCTION

The need…

The repair, renovation and construction of new schools is an increasingly complex endeavor in the United States. There are over 97,000 public school buildings comprising an estimated 6.6 billion sq ft of space on over 1 million acres of land.[1]

According to a 1999 study by the National Center for Education Statistics (NCES), the unmet need for school construction and renovation was estimated to be $127 billion. This amount was higher than the previous estimate of $112 billion given by the General Accounting Office (GAO) in 1995.[2] Some other organizations believe the need is actually far larger than $127 billion.[3] In 2000 the National Education Association gave an estimate of $322 billion for fixing and modernizing the nation's schools. The steep increase was due, in part, to the study's more comprehensive state-by-state analysis as well as the inclusion of $54 billion for technology improvements, such as wiring for Internet access.

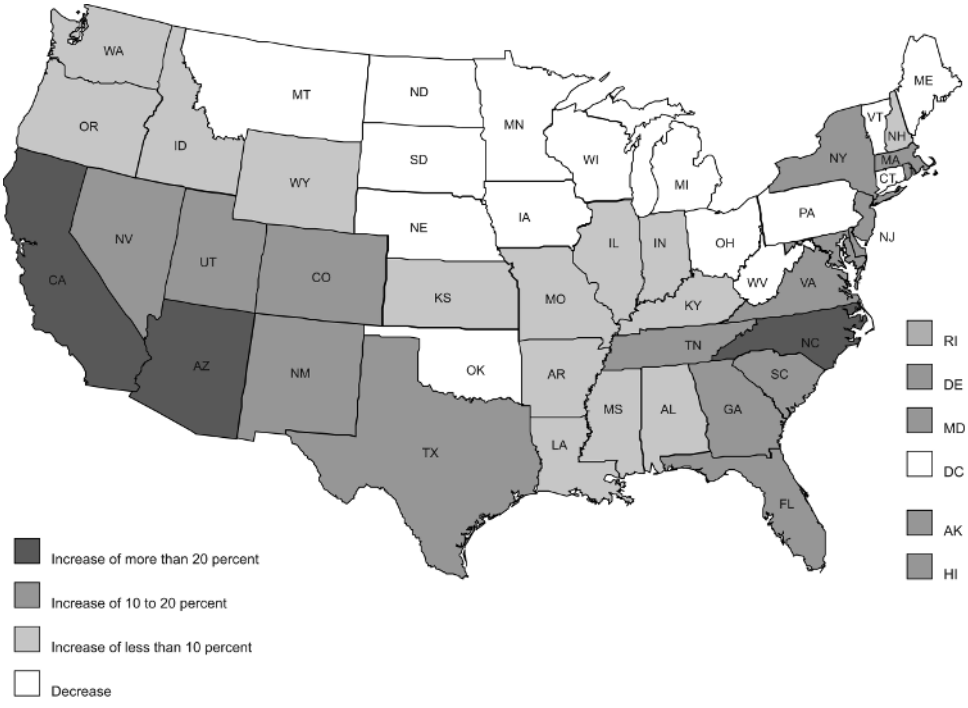
NCES indicated in 1999 that three-quarters of the nation's schools report needing funds to bring their buildings into a "good overall condition." The Department of Education (ED) has documented that the average age of a public school building is 42 years, an age at which schools tend to deteriorate.

The backlog of renovations and repairs is only part of the challenge. After a decline that generally ended in the 1980s, school enrollment steadily increased, reaching in 2005 a record total of 55 million for public and private elementary and secondary schools. A further increase of 10 percent is projected before 2017. This growth has not been and will not be evenly distributed geographically: States in the Midwest, South, and West are projected to experience growth, while enrollment in others is expected to stabilize or in some areas, such as the Northeast, to decline.[4]

Even in communities with stabilizing enrollment, school construction is likely to be an issue. The need arises not only from building age and obsolescence, but also from the evolving nature of K–12 education.

Since the late 1800s schools have been under continuous pressure to accommodate a broader curriculum, reduced class sizes, and more specialized programs, such as preschool, special education, and English as a second language, as well as new administrative, instructional, and communication

1. U.S. Department of Education, National Center for Education Statistics, NCES Common Core of Data (CCD) Survey, *Local Education Agency Universe Survey: 2005–06.*
2. U.S. General Accounting Office report, *School Facilities: Construction Expenditures Have Grown Significantly in Recent Years,* March 2000, http://www.gao.gov/archive/2000/he00041.pdf.
3. Laurie Lewis et al., "Condition of America's Public School Facilities: 1999," NCES website, http://nces.ed.gov/surveys/frss/publications/2000032/index.asp (accessed 6/2009).
4. William J. Hussar and Tabitha M. Bailey, *Projections of Education Statistics to 2017,* NCES website, http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2008078 (accessed 6/2009).



Projected Education Statistics to 2008. Source: U.S. Department of Education, National Center for Education Statistics.

technologies. These developments have generated the need for significant additions to and reconfigurations of existing facilities. Moreover, they have probably contributed to the need for new schools. As graduation requirements have changed and programs such as those listed above have been added, schools built in the 1950s and 1960s that may have originally accommodated 2,000 students now effectively hold 1,800 or fewer.

As education and facilities continue to evolve, demand for additions and reconfigurations is inevitable. Schools constitute one of the building types whose built environment has a direct impact on the quality of the functions they accommodate—in this case teaching, learning, and community activities. So long as educating the next generation is a primary task for our increasingly connected planet, the planning, design, and construction of schools will be an evolving and essential challenge.

This chapter addresses the educational changes influencing educational architecture and looks at the design process necessary to successfully address new developments. It covers the process of programming and planning, along with the specific types of spaces generally expected for a wide range of school types.

There are quantitative methods for defining and illustrating the spaces required for various school areas. Programming, however, can be as much an art as a science. The types and designs of the spaces we build should be directly related to changes in educational practice. As these changes become

more common in the districts for which we design, they influence the size, configuration, and number of program areas in mainstream schools. As improved spaces are developed, they can, in turn, influence educational practices in positive ways. Such a feedback process can help drive innovation in the design of schools that are relevant not only today but also long into the twenty-first century.

THE LEARNING PROCESS

Probably the most important issue school designers (and their clients) must understand is how the physical environment relates to and can support the learning process. As a child grows, he or she typically learns in different ways, and the physical environment of the school should reflect this characteristic and process. A well-designed environment can help stimulate and support teaching, whereas a poorly designed school can inhibit learning. Although some experienced design professionals understand this interrelationship, there have been numerous recent studies to determine the relationship of teaching and learning to the physical environment.

One of the most common references is Benjamin S. Bloom's *Taxonomy of Educational Objectives* (1956). Despite being more than a half-century old, the taxonomy has needed only a few recent revisions (Anderson & Krathwohl 2001) and outlines the hierarchy of thinking skills that a student uses. Teachers and curriculum providers have used this hierarchy to plan lessons that introduce new material using lower-order thinking skills, such as identification, and then build upon that new knowledge with higher-order skills, such as analysis and evaluation. The design implications of this hierarchy are that teaching is no longer about a teacher standing at the front of a class lecturing to students whose sole job it is to memorize their notes. In order for students to engage in the higher-order thinking skills of Bloom's taxonomy, teachers and students must be free to utilize the classroom space in new ways to create more meaningful lessons.

Although other taxonomies have been introduced, Bloom's provides useful background for programming any school. Information drawn from this important work is included in the table on the following pages. Bloom's work has been fundamental in planning the educational programming for each age group. It has also helped to move school planning away from the rigid standard classrooms that dominated school design in the early decades of the twentieth century. Rooms and furniture scaled to the children,

> Those involved in the design of school buildings cannot think only in terms of physical structure. They must think about the individuals who will use the building. Think about the role the building plays in supporting teaching and learning and the full development of all of each student's potentials. If the architect keeps these things in mind, he may be able to contribute…to the achievement of the educator's goals…by creating a building that is a tool for the teacher and an expression of the school's educational approach…by creating an atmosphere, a mood, to aid the student in every learning task set before him…by making the school a place the student looks forward to entering, and one he regrets leaving. (Perkins 1957, p. 62)

DEVELOPMENTAL GUIDEPOSTS FOR CHILDREN AND ADOLESCENTS

	PHYSICAL	EMOTIONAL
Early childhood (ages 3–5)	• Body growth slows, more adult proportions develop. • At 6, neural development 90% complete. • From 4 to 8 years, lymphoid development increases from 40% to 90%. • Most children farsighted. • Muscle development begins at 4 years, but larger muscles dominate.	• Tend to fear imaginary or anticipated dangers. • Begin to understand concept of taking turns and tend to imitate adults. • Crying and tantrums diminish; anger can be expressed in words (often by threatening or yelling). • Anger directed at cause of frustration, retained for longer periods of time, but 4-year-olds begin to seek ways to hide it from others. • Channeling anger and frustration is important.
Middle childhood (ages 6–9)	• Apparent difference between growth rate of girls and boys (girls closer to end growth states, boys taller and heavier). • Nearsightedness may begin to develop at 8 years. • 6-year-olds use whole bodies for activities and large muscles are more developed; 7-year-olds more cautious and show ease with fine motor skills; 8-year-olds develop fine motor skills and increased attention spans. • Nervous habits begin to appear at age 7.	• 6-year-olds begin to assert independence and demonstrate confidence. • 6-year-olds fear the supernatural. • 7-year-olds are more stable, narcissistic, polite, responsive, empathetic, less aggressive, and can draw connections between cause and effect. • 8-year-olds demonstrate greater independence, vacillate between moods, and begin to sense how others feel toward them. • 7- and 8-year-olds discover some of their limitations and may hesitate to try new tasks, but 8-year-olds seek to create an external image of competence and confidence.
Late childhood (ages 9–11)	• More resistance to disease. • Steady increases in body measurements—height and weight (girls more than boys)—and muscle growth. • Have fine motor skills. • May feel uncomfortable with scrutiny. • Many girls begin showing signs of puberty.	• Fear exclusion from peers. • Prone to outbursts but try to control them. • 10-year-olds mild-tempered, seek reassurance from others; anger comes and goes quickly. • 10-year-olds most afraid of heights and dark. • 11-year-olds fear school, friends, for parents' welfare, strange animals, threatening world events; are more easily angered, often resulting in physical violence, but can control outbursts more appropriately.
Early adolescence (ages 12–14)	• Enter pubescence, puberty, and postpubescence. • Activated primary and secondary sex characteristics.	• Emotions vacillate; responses are inconsistent. • 12-year-olds may develop a derogatory sense of humor to control emotions. • 13-year-olds withdraw from others, tending toward secrecy and sullenness. • 14-year-olds use derogatory humor as defense and primary form of communication.
Late adolescence (ages 15–18)	• Height and weight stabilize. • Girls generally physically mature by 18, boys by 19.	• Feel restrained or controlled by adults. • Have insecure self-image; may fear inadequacy. • Focus attention on opposite sex or close peers. • Feel challenged to find comfortable self-image.

SOCIAL

- Begin to understand concept of taking turns and tend to imitate adults.
- 4-year-olds prefer to spend time playing and cooperating with others and can pick up social cues from surroundings.
- 5-year-olds prefer to play with others.
- May create imaginary playmates if deprived of contact with other children, but most will outgrow these playmates by age 5.

LINGUISTIC

- Age 3: 600 to 1,000 words, simple sentences.
- Age 4: 1,100 to 1,600 words, good syntax, plurals used, fluency improves, 4-, 5-, and 6-word sentences, 3- to 4-syllable phrases.
- Age 5: 1,500 words, nearly perfect syntax, fluency with multisyllabic words, 5- to 6-word complete compound or complex sentences.

- Family influence decreases; peers are more important; teachers become authority figures.
- 6-year-olds have many internal conflicts, resulting in capriciousness.
- 6-year-olds choose playmates on qualities of age and size (not gender or ethnicity), and 7-year-olds are more aware of social status or ethnicity differences among themselves.
- 7-year-olds are self-critical and often disassociate themselves from frustrations.
- 7-year-olds are well mannered unless bored, and 8-year-olds are more developed socially.
- 7-year-olds are more conscious of position among peers; boys and girls play separately.
- 8-year-olds prefer company and approval of peers, and exhibit more self-control and modesty.

- Socialize in exclusive groups with own sex (boys' groups gravitate toward bravado and competition, and girls' groups are well structured and more concerned with maturity).
- Develop important individual friendships, which are often fluid.
- Ties to family less important than ties to peers; adult shortcomings looked at critically, often leading to conflicts.

- Motivated by desire to fit in with peers, which prevents individual expression but emboldens adolescents to assert independence from home.
- Peer groups are exclusive and develop from single-sex to coed.
- Intensely drawn to a best friend, believing that only this other person understands.

- Independence asserted, power struggles with parents, most concerned about social life.
- If uncomfortable with adulthood, may withdraw to former behaviors.

EIGHT INTELLIGENCES			
TYPE	**LIKES TO**	**DEVELOPS RELATED SKILLS**	**LEARNS BEST BY**
Linguistic intelligence: "the word player"	Read Write Tell stories	Memorizing names, places, sayings, dates, and trivia	Saying, hearing, and seeing words
Logical/mathematical intelligence: "the questioner"	Do experiments Figure things out Work with numbers Ask questions Explore patterns and relationships	Math Reasoning Logic Problem solving	Categorizing Classifying Working with abstract patterns/relationships
Spatial intelligence: "the visualizer"	Draw, build, design, and create things Daydream Look at pictures/slides Watch movies Play with machines	Imagining things Sensing changes Reading maps, charts	Visualizing Dreaming Using the mind's eye Working with colors/pictures
Musical intelligence: "the music lover"	Sing, hum tunes Listen to music Play an instrument Respond to music	Picking up sounds Remembering melodies Noticing pitches/rhythms Keeping time	Rhythm Melody Music
Bodily/kinesthetic intelligence: "the mover"	Move around Touch and talk Use body language	Physical activities (sports/dance/acting) Crafts	Touching Moving Interacting with space Processing knowledge through bodily sensations
Interpersonal intelligence: "the socializer"	Have lots of friends Talk to people Join groups	Understanding people Leading others Organizing Communicating Manipulating Mediating conflicts	Sharing Comparing Relating Cooperating Interviewing
Intrapersonal intelligence: "the individual"	Work alone Pursue own interests	Understanding self Focusing inward on feelings/dreams Following instincts Pursuing interests/goals Being original	Working alone Individualized projects Self-paced instruction Having own space
Natural intelligence	Acute awareness of patterns in nature	Sensitive to features of the natural world (clouds, rock configurations)	Discriminating between living and man-made things

more flexible classroom configurations, and many other physical modifications have been adopted to reflect the changes that have been incorporated in educational programming.

Howard Gardner's *Frames of Mind* (1983) originally listed seven types of learning "intelligences." In 1996 this listing was expanded to eight, where it remains despite some additional proposed ideas. In theory, all eight forms of intelligence are equally valuable and viable. Historically, school curricula have favored certain styles of learning over others. In the United States a bias toward verbal/linguistic and logical/mathematical intelligences has influenced the facility planning, design, and furnishing of American schools. Yet if a student's strength is artistic, the classroom and teaching can be adapted to make art the door to learning.

This theory does not mean teaching every lesson in eight different ways. Instead, it suggests personalization. Gardner uses the image of a room with a number of doors. The room represents the subject being taught, and the doors symbolize alternative ways for a student to enter the room and access the topic. In outline, this theory suggests structuring the learning process so that the following occur:

- Students enter through the door related to their dominant intelligence. Each access point consists of lessons, learning centers, activities, etc.
- Students also study the topic from the other points of access after having acquired a basic understanding using their dominant intelligence.
- Students work cooperatively with others who may have come to the topic through a different door. This clarifies ideas and reinforces the subject learned.
- Students synthesize the knowledge they have collected about a topic.
- Students teach what they have learned to others and apply what they have learned to other topics.

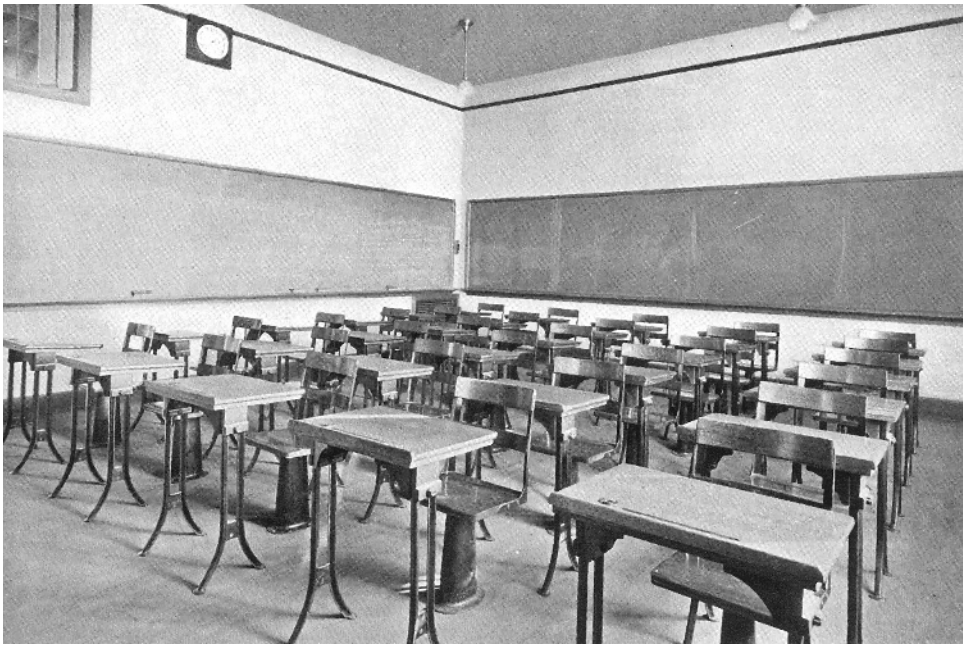
▲ *A successful teaching environment still begins with the relationship of a good teacher with his or her students. Photograph by Rachael Perkins Arenstein.*

Many teachers, as well as a growing number of schools, are using this approach. The August 1997 issue of *School Planning & Management* described a renovation program at the Saltonstall School in Salem, Massachusetts. The goal of the renovation was "to create an incubator for innovative programs in elementary education statewide." One of the decisions was to incorporate Gardner's theory, which meant the following:

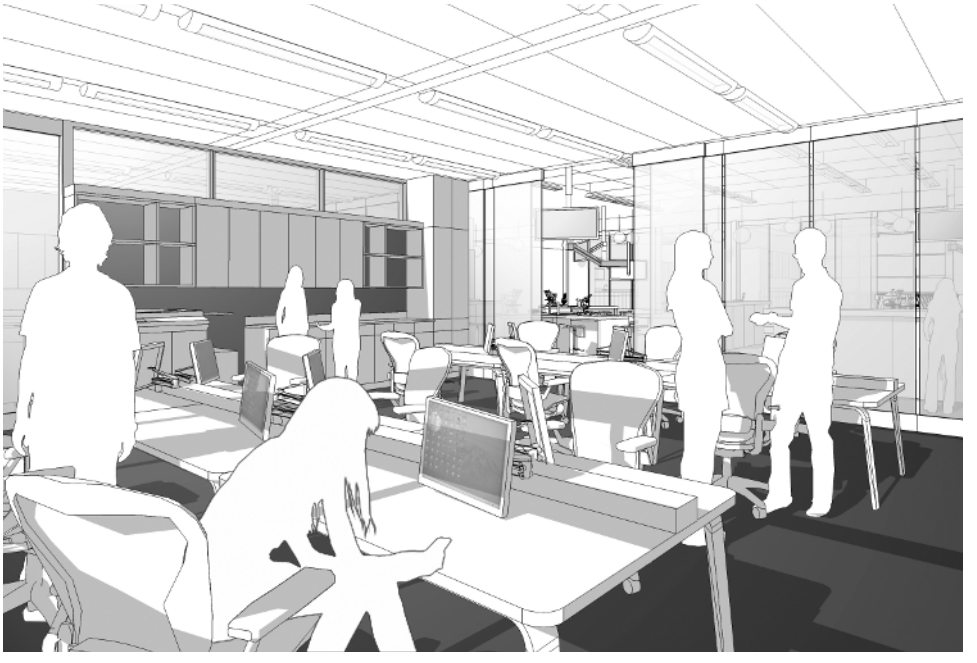
- A focus on technology, inasmuch as "good multimedia programs present material verbally, spatially, musically, and logically." Instead of having one electrical outlet on a wall, the classrooms were wired to support computers, media presentations, a listening center, an overhead projector, and other such equipment.
- The renovation priorities were ranked by their impact on learning. Money was shifted from a number of typical building renovation priorities to technology and other teaching aids. For example, a decision was made to add sinks in each classroom for art and science projects. This innovation cost $1,000 per sink but eliminated travel to a special room and increased the number of activities that supported students with high spatial and kinesthetic intelligence.
- Multipurpose spaces were created to permit flexible teaching areas. Even the auditorium has no fixed seating.
- Outdoor balconies adjacent to classrooms were used as teaching areas for weather and science topics.
- A "flow room" was created to provide a place where a student can focus on a topic of particular interest. "Flow" is designed to foster a focused state of attention. Flow is connected to the multiple intelligences theory in that students are more likely to have flow experiences in activities they find interesting, leading them to invest time and effort in difficult tasks—-an important learning skill.

Regardless of whether Gardner's multiple intelligences theory or other theories are applied to school design, it is clear that the physical environment should reinforce the educational program. No fixed classroom environment will do the job properly. Training materials for teachers also reinforce the relationship of the classroom's physical environment to the learning process. For example, the materials used by the national program Teach for America make the following recommendations:

- An open, stimulating environment is one that invites students to explore and participate, [and] makes it easy for students and the teacher to carry out learning activities (e.g., students should be able to see the chalkboard, students can easily access learning materials, teachers can circulate easily among the students, etc.).
- Organize students [if you use assigned seating] into heterogeneous groups for cooperative learning, or design seating arrangements to minimize unnecessary talking or maximize collaboration between students.
- Many students need personal space to feel that they belong to the classroom and that they can keep their personal belongings safe.
- Because most people work best in a variety of different settings, you may want to create different opportunities for students to sit up straight, stand, lean, lounge, etc. Some teachers use beanbags or carpets to provide alternative spaces for students.

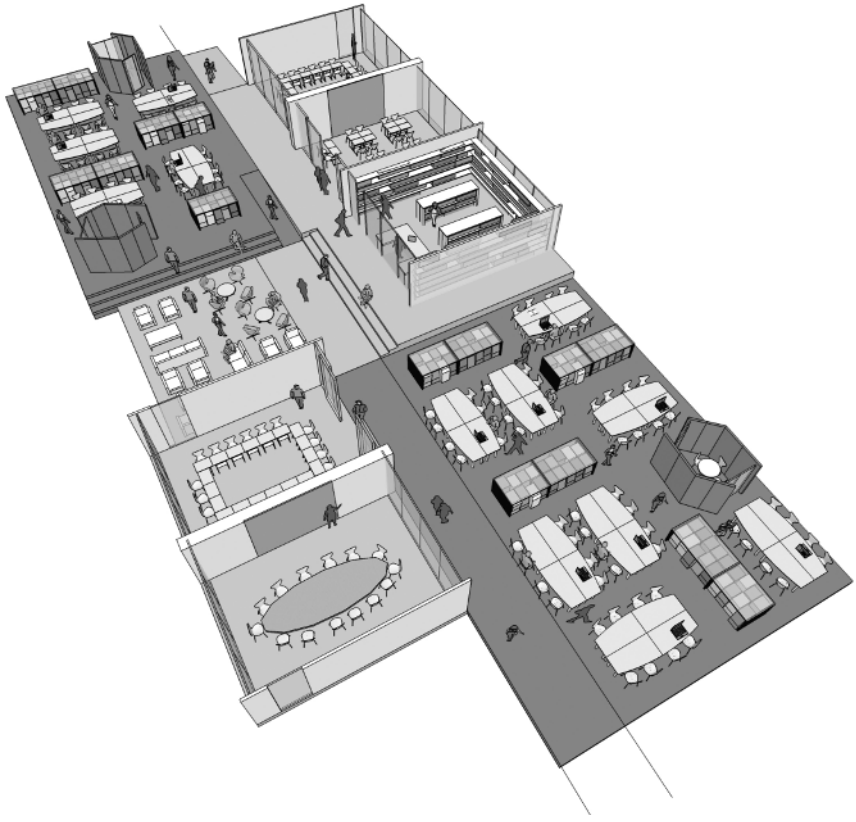


The classroom has evolved from the rigid seating plan illustrated in Modern School, *a 1915 precursor to this book. Courtesy of HMFH Architects.*



Contemporary classrooms feature integrated technology with flexible furnishings that allow students a variety of educational settings, including team and project-based learning. Perkins Eastman. Courtesy of Perkins Eastman.

The changing nature of classrooms is represented here by both traditional and nontraditional studio-style settings. Avenues, The World School, New York, New York. Perkins Eastman. Courtesy of Perkins Eastman.



- Learning centers are areas in a classroom where small groups of students can…focus on specific skills or content areas.
- Visual displays are an important aspect of a classroom environment that supports student learning [and offer] a great opportunity to focus your students on their academic goals and reinforce the material that you are teaching.

The Teach for America guidelines reflect a shift in thinking about the learning process. In his book *In School* (1995), Ken Dryden concluded, "This past decade, the focus of education has shifted back to the classroom.… People have come to realize again that a school works in the classroom—or it doesn't work at all; that education may be about teaching and teachers, but really it is about learning and kids; and that education reform may be for *all* kids, but really it is for the majority of kids in every class who are doing just adequately or worse." This shifting focus has been influenced by the impact of self-directed, real-world, project-based learning. Spaces where students can work collaboratively support the evolution of teachers from old-style dispensers of information to present-day "guide-on-the-side" mentors and coaches.

SCHOOL PROGRAMMING AND PLANNING GUIDELINES

General Considerations

In the last 15 years there has been remarkable advancement in the process and guidance available to school districts and private institutions alike. There is a large amount of information on design guidelines and standards available from many sources. The Internet has made it possible to look at a variety of planning and design resources developed by state departments and private organizations, including guidelines from individual states, university think tanks, and online repositories such as www.edfacilities.org, www.designshare.com, and www.eric.ed.gov, which provide access to more than 1.2 million bibliographic records of journal articles and other education-related materials.

Finding information or "standards" to guide the planning, design, and construction of school facilities is not a difficult task. However, these standards vary. They can be influenced by the learning process and curricula of different age groups as well as the issues related to children with special needs. It is not possible to cover every variation in these planning standards; rather, in order to prepare the design team and client to make informed decisions, this chapter introduces representative program guidelines for the four most common types of public schools:

- Kindergarten and preschool
- Elementary school
- Middle school
- High school

These basic school types may be organized in a number of ways:

- Elementary, pre-K–3
- Elementary, pre-K–5
- Elementary/middle, pre-K–8
- Middle, 6–8
- Middle/secondary, 6–12
- Secondary, 9–12
- Elementary/middle/secondary, pre-K–12

This chapter also covers a number of other variations wherein schools may have a specific purpose, focus, or type of leadership, such as the following:

- Special needs schools (for children who are physically or emotionally disabled, blind, deaf, etc.)
- Vocational/technical schools
- Charter schools
- Alternative schools
- Selective academic and magnet schools
- Private (boarding and day schools), parochial, and international schools

Note that this book focuses primarily on public schools. However, much of the guidance given here applies equally to private school design. Although there are subtle distinctions between public and private schools, and the latter are not subject to the same regulations as public schools, most are trying to accomplish the same mission.

Programming and Planning

Determining school building capacity

When beginning the planning process of a new or renovated facility, one of the most common questions asked—and, from a programming point of view, one of the first questions that must be answered—is how many students the facility can accommodate. The answer is generally given as the

programmed *effective capacity*. This number can be calculated in a variety of ways and must be agreed upon by all parties involved before the process of planning the school can begin.

This section outlines the basics of determining the capacity of a school. The method used varies depending on a number of factors. However, there are two basic capacity calculations most frequently used, one for elementary schools and one for middle/high schools.

Before we look at calculations, it is important to understand the terms we will be using. The following definitions are common when discussing the capacity of a school and for the most part are interrelated.

Definition of terms

Teaching stations are defined as areas in which students receive instruction on a regularly scheduled basis. These spaces include not only classrooms but also music rooms, science labs, art rooms, fitness rooms, gymnasiums, media centers, theaters, and so forth. Because each student can occupy only one place at a time, for middle schools and high schools, such "cocurricular" spaces relieve the classrooms of a requirement to accommodate the entire student body at one time.

The *utilization factor,* expressed as a percentage, provides a facility with a certain degree of scheduling and programmatic flexibility in scheduling teaching stations occupied by a section of students. A typical utilization factor is 80–90 percent, and is determined by the specific scheduling and practices of the individual school.

Effective capacity is the number of students that can be comfortably accommodated by a facility at any given moment. To calculate the effective capacity of a school, the number of teaching stations is multiplied by the number of students per teaching station, multiplied by the requested utilization factor. The utilization factor accommodates the desired degree of flexibility.

A facility's *maximum capacity* is the total number of teaching stations multiplied by the maximum design value per station.

Efficiency is a measure of the number of teaching stations occupied during a given period of the day: the more teaching stations occupied during a given period, the higher the efficiency. Likewise, the higher the utilization factor, the higher the facility's planned efficiency will be.

Design value is defined as the number of students intended to occupy a teaching station during any scheduled period. For public schools in the United States, design values may range from 22 to 28 for an elementary school, and from 22 to 30 or higher for a high school. Private schools often focus on reducing class size below public school levels. Design value can also mean the total number of students a school building can effectively accommodate. The definition depends on the context in which the term is used.

Determining elementary school capacity

The method used for determining effective capacity is different for the elementary school than for the middle and high school. For our purposes, an elementary school capacity will be based on a model in which students have a "homeroom" or regular classroom. When attending classes in a specialized classroom, such as art or music, in other parts of the building, no other students occupy their room. Most elementary schools do not operate on a schedule based

on specific "periods" of time, and consequently do not change classrooms during the day for different subjects. The number of special classrooms (science labs, art, etc.) will be a reflection of the enrollment and the curricular focus envisioned for the school. Therefore, the capacity of an elementary school is a fairly simple calculation of multiplying the number of regular classrooms by the design value of each one. For example:

26 classrooms × 22 students = capacity of 572

In this case, the utilization rate is assumed to be 100 percent, or maximum capacity, and represents the facility's maximum capacity.

In some cases there may be a difference between lower elementary school design values and those of the upper elementary grades—for example, K–2 may be planned at 18 students per teaching station, and grades 3–5 at 22 per station. It is important to agree on the design values at the start of the planning process, because it gives the facility planners a figure to use in determining the number of classrooms required, and also governs the size requirements for support spaces such as cafeterias, science labs, art rooms, and libraries.

Most newly designed elementary school facilities in the United States include art, music, computer awareness and keyboarding, and sometimes wet lab science and project spaces. Spaces for these programs do not affect the design capacity of the facility because when students are using these facilities, their classrooms will remain empty. This is the main difference in determining building capacity between elementary school facilities and middle/high school facilities.

Determining middle school and high school capacity

The following methodology can apply to both middle and high school planning, as there is no appreciable difference between the two in scheduling utilization. Either can be influenced by the program and scheduling system implemented to operate the school. Most districts have a standard utilization rate, which can vary widely from district to district.

Unlike elementary schools, middle and high schools generally operate on a bell schedule in which students do not "own" a classroom. As they move around the building, students continually settle into teaching stations. It is very difficult to achieve a utilization factor of 95 percent or above in either a middle or a high school, because it is very difficult to schedule every teaching station every period of the day. Efficiency of 100 percent is almost impossible to achieve, and if it is, generally represents an overcrowded or poorly operated school.

Standard utilization rates

95 percent efficiency. Mandated in some states, such as Florida, 95 percent efficiency can be achieved only by "floating" teachers and providing them with offices for use outside of classrooms. Utilization rates this high can impose some restrictions on scheduling flexibility and limit the ability to add programs or operate classes of less than maximum capacity, such as advanced placement (AP) classes, where there might be 10 or fewer students.

90 percent efficiency. More flexible than 95 percent efficiency, a 90 percent rate can provide dedicated classrooms for some teachers and for programs such as foreign language.

85 percent efficiency. The most common percentage used when planning a new school without any specific direction from the district, 85 percent efficiency can be thought of as an 8-period day with each teaching station being used during 7 of the 8 periods (in actuality 87 percent).

80 percent efficiency. Offering great flexibility, 80 percent efficiency opens up the possibility for innovative scheduling (certain types of "block schedules" in which each student has fewer classes per day for a longer period of time). Teachers can have their own rooms, or space can be provided for a greater number of programs with smaller enrollments (less than the design

TEACHING STATION UTILIZATION RATES

PERIODS PER DAY	AVERAGE USAGE PER STATION (PERIODS)	UTILIZATION RATE (%)	NOTE
8	7.5	94	Most of the teaching stations will be occupied 100% of the time.
8	7	87	Fairly typical utilization rate for planning purposes.
8	6	75	Each teacher might have his or her own room.[1]
6	5	83	Represents some form of modified schedule.
6	4	67	Too low for planning purposes and not recommended.
5	4	80	Some variation of a block schedule,[2] and as low a utilization as is normally permitted.
5	3	60	Too low for planning purposes and not recommended.
4	3.5	88	2 x 4 block schedule; individual teaching stations are shared by more than one teacher.
4	3	75	2 x 4 block schedule; represents utilization with some capacity for growth. Common in international schools and some public schools utilizing a block schedule. This is a typical utilization for this type of schedule.
4	2.5	63	Block schedule; represents utilization when individual rooms are "owned" by a single teacher, teaching 5 of 8 periods. Generally considered too low for planning a new facility.

1. One lunch period and one planning period per teacher
2. A block schedule is a type of academic scheduling in which each student has fewer classes per day for a longer period of time. A 2 × 4 block schedule is an 8-period "day" spread over two days. To keep the table consistent, only one day is shown (4 periods in a single day). Typical block schedule utilizations are built around each teacher teaching either 6 of the 8 periods (3 of 4 per day) or in some cases 5 of 8 periods (2.5 of 4 per day).

value per teaching station), such as AP classes.

75 percent efficiency. Providing tremendous flexibility in scheduling and program opportunities, 75 percent efficiency is used primarily when a district wants to build in capacity for future increases in enrollment.

Schedule can also influence the desired utilization. As outlined in the table at left, the utilization rate is determined by the number of periods per day a teaching station is used as compared to the total number of periods in a day.

Estimating the gross area of a building

Net square feet (NSF) refers to the net usable area of specific program elements as defined in the building's "program." Gross square feet (GSF), or gross building area, is the entire area of the plan of the school building, and usually refers to gross area of a building by measuring from the outside of its exterior walls and including all vertical penetrations, such as elevator shafts, interior and exterior walls, corridors, stairwells, mechanical rooms, and other built space not specifically identified in the program or defined as "net" square footage. For example, if we refer to a 1,000 NSF flexible laboratory space, we mean a space that has 1,000 sq ft of actual usable space within its four walls.

Different regions of the country have different average square footages for their schools. It is typical to find, for example, that schools north of 30º north latitude begin to get larger due to increased mechanical system requirements and the need for virtually all program areas to be indoors. Conversely, schools south of 30º north latitude begin to get smaller due to the lack of major heating equipment and the ability to accommodate some net and gross area functions outdoors. Especially in Florida, New Mexico, Arizona, and southern California, one might find some gymnasium space replaced with an outdoor court, or corridor space might be on the outside of the building.

Thus, while interesting, national media figures in school size per student are rarely useful in programming. For example, *School Planning and Management*'s "2008 Construction Report" gives median sizes of new schools as follows:

Elementary schools	124 sq ft/student
Middle schools	146.6 sq ft/student
High schools	166 sq ft/student

But their statistics go on to illustrate a wide range:

Lowest Quartile	Top 10%
Elementary schools	
105.5 sq ft/student	178.6 sq ft/student
Middle schools	
125.3 sq ft/student	218.8 sq ft/student
High schools	
141.1 sq ft/student	460.0 sq ft/student

Therefore, it is usually important to develop a program that reflects the particular needs and aspirations of each school.

Net-to-gross calculations

Once the capacity has been determined and the net programmed areas identified, an estimated GSF can be developed. During the programming phase, this can be calculated using the chart on page 17. "Northern climate" for this purpose is above 30° north latitude. Grossing factors below 30° north latitude can be reduced if certain functions, such as circulation or locker space, are

In warmer climates, the division between indoor and outdoor portions of a classroom can become blurred. American International School: Riyadh, Riyadh, Saudi Arabia. Perkins Eastman. Courtesy of Perkins Eastman.

moved to the outdoors. In exceptionally hot climates, these functions tend to remain indoors and thus the grossing factors used above 30° north latitude might be more accurate.

Urban grossing factors are generally higher. When a school building adds floors, a greater percentage of the gross area must be allocated for exiting and mechanical space requirements. Elementary schools generally have fewer rooms and, thus, smaller grossing factors than middle and high schools. Small, single-story buildings are potentially the most efficient from a gross area standpoint (no exit stairs); however, they may be more expensive because of increased exterior enclosure, foundation, and roof area.

The tables on pages 17–18 offer a generalized look at the relationships between size, location, and grade levels of buildings. The grossing factors given in the tables are based on the experience of the authors, who have found that programmers commonly underestimate the grossing factors required, often at the request or guidelines of the owner/client. The numbers in these tables are given for reference purposes to help establish a starting point. Grossing factors should be carefully reviewed as necessary for each individual project.

For all schools: calculating classroom size

Learning environments include all programmed space within the building where both formal and informal learning takes place. The most common unit is the basic classroom, designed for groups ranging from 16 to 30 students. Groupings smaller than

ELEMENTARY SCHOOL GROSSING FACTORS BY REGION, SIZE, AND POPULATION DENSITY*

CONDITION	STUDENT POPULATION	URBAN GROSSING FACTOR	SUBURBAN GROSSING FACTOR	RURAL GROSSING FACTOR
Northern climate Large support facilities	500	1.60+	1.52+	1.50+
	750	1.60–1.63	1.52–1.59	1.50–1.55
	1,000	1.58–1.60	1.48–1.52	1.45–1.50
	1,200	1.55–1.58	1.42–1.48	1.40–1.45
Northern climate Compact support facilities	500	1.62+	1.54+	1.52+
	750	1.62–1.65	1.54–1.59	1.52–1.55
	1,000	1.58–1.62	1.52–1.54	1.48–1.52
	1,200	1.50–1.58	1.45–1.52	1.40–1.48
Southern climate Large support facilities	500	1.50+	1.47+	1.45+
	750	1.50–1.55	1.47–1.50	1.45–1.50
	1,000	1.45–1.50	1.45–1.47	1.40–1.45
	1,200	1.40–1.45	1.40–1.45	1.35–1.40
Southern climate Compact support facilities	500	1.52+	1.49+	1.47+
	750	1.52–1.57	1.49–1.54	1.47–1.52
	1,000	1.47–1.52	1.43–1.49	1.40–1.47
	1,200	1.42–1.47	1.38–1.43	1.35–1.40

* To be multiplied by the net programmed area.

this are classified as *small group rooms,* and larger than this are classified as *large group instruction rooms.* Classroom sizes vary depending on the grade level served and the number of students the space is planned to support, as shown in the table on page 19.

Urban school classrooms are often smaller than their suburban counterparts. The cost of land and construction can be considerably more, which often forces these schools to build more spatially economic structures. Conversely, pressure on the classroom square footage can come from class size, which in urban schools can often be larger. The table on page 19 illustrates the potential reduction in area found in urban public schools.

Several factors influence classroom size and groupings. Each of the following factors should be discussed early in the planning process, prior to establishing the classroom size:

- State and district guidelines.
- Maximum anticipated class size.
- Use of any special technologies or projection equipment (change in use to a technology or distance learning lab).

MIDDLE SCHOOL AND HIGH SCHOOL GROSSING FACTORS BY REGION, SIZE, AND POPULATION DENSITY*

CONDITION	STUDENT POPULATION	URBAN GROSSING FACTOR	SUBURBAN GROSSING FACTOR	RURAL GROSSING FACTOR
Northern climate Large support facilities	500	1.65+	1.60+	1.57+
	750	1.60–1.66	1.55–1.60	1.52–1.57
	1,000	1.57–1.64	1.52–1.57	1.49–1.54
	1,200	1.52–1.62	1.50–1.55	1.46–1.51
	1,600	1.45–1.55	1.46–1.52	1.40–1.49
Northern climate Compact support facilities	500	1.65+	1.60+	1.57+
	750	1.60–1.66	1.55–1.62	1.52–1.59
	1,000	1.57–1.64	1.52–1.59	1.49–1.56
	1,200	1.52–1.62	1.50–1.57	1.46–1.54
	1,600	1.45–1.60	1.46–1.55	1.40–1.52
Southern climate Large support facilities	500	1.53+	1.50+	1.50+
	750	1.50–1.53	1.45–1.50	1.43–1.50
	1,000	1.45–1.50	1.43–1.45	1.40–1.43
	1,200	1.40–1.45	1.40–1.43	1.38–1.40
	1,600	1.40–1.43	1.37–1.41	1.35–1.40
Southern climate Compact support facilities	500	1.53+	1.50+	1.50+
	750	1.52–1.53	1.47–1.50	1.45–1.50
	1,000	1.47–1.52	1.45–1.47	1.42–1.45
	1,200	1.45–1.47	1.40–1.45	1.38–1.42
	1,600	1.40–1.45	1.37–1.41	1.38–1.40

* To be multiplied by the net programmed area.

- Potential changes in future programs and room use (e.g., the future use of a classroom as an art room), primarily at the elementary level.
- Number of support and self-directed spaces available for break-out use, especially in middle and high school (fewer small group spaces = larger classrooms).
- Likelihood of increased class size beyond the design value used in planning the classroom (high probability = larger classroom).
- Alignment of classroom size across several grade levels to allow for flexibility in reconfiguration should an enrollment "bubble" in a particular grade require more

TYPICAL SUBURBAN SCHOOL CLASSROOM SIZES[1]

GRADE LEVEL	16 TO 20 STUDENTS (SQ FT)	21 TO 24 STUDENTS (SQ FT)	25 TO 30 STUDENTS (SQ FT)
Grades pre-K–1	1,000–1,200	1,100–1,200	Not recommended
Grades 1–2	900–1,200	1,100–1,200	Not recommended
Grades 3–5	850–900	900–1,000	950–1,100
Grades 6–8[2]	725–825	750–850	850–950
Grades 9–12[2]	725–825	750–850	850–950

1. Areas given assume typical suburban campus standards. Minimum allowable classroom size may be governed by state regulations and should be verified early in the planning process.
2. In many cases, state and district standards for middle and high school classroom sizes are the same, or the difference between them is negligible. Establishing a common size for both during planning will provide a certain degree of future flexibility in programming space.

TYPICAL URBAN SCHOOL CLASSROOM SIZES[1]

GRADE LEVEL[2]	16 TO 20 STUDENTS (SQ FT)	21 TO 24 STUDENTS (SQ FT)	25 TO 30[3] STUDENTS (SQ FT)
Grades pre-K–1	800–925	925–1,000	Not recommended
Grades 1–2	750–875	875–950	950–1,100
Grades 3–5	650–800	800–875	875–1,100
Grades 6–8	625–725	725–825	825–1,000
Grades 9–12	600–700	675–850	775–950

1. Areas given assume typical urban campus standards. Minimum allowable classroom size may be governed by state or district regulations and should be verified early in the planning process.
2. In urban districts where building configurations contain two or more of the listed grade-level groupings (e.g., grades pre-K–8 or 6–12), it is advisable to establish a common size for all classrooms to maximize future flexibility.
3. In districts where enrollments are expected to increase, it is advisable to build the largest classrooms feasible to allow for future internal growth.

classrooms in a given year. Establishing a common size also helps in creating a repeatable structural grid and generally produces a building that is simpler and easier to plan.

As mentioned previously, states often provide standards. Depending on how the facility is funded, these standards represent the minimum square footage to be allocated. For special education classrooms, states often require fewer students in the classroom as opposed to mandating larger classroom sizes. The examples in the table on page 21 are typical of state guidelines for special education classrooms.

Tables allow flexibility in student arrangements and can help with class size variations. Harvey Milk School, New York, New York. Perkins Eastman. Photograph by Seth Boyd.

Most districts attempt to keep the number of students per classroom lower than their maximum design value. Typical ranges are 16–20 for pre-K through grade 2, 22–25 for elementary schools, and 23–30 for middle and high schools. The most common design value for middle and high schools is between 23 and 25 students.

Classrooms should be designed to allow an increase in the student population of three to five students above the established design value to allow additional capacity within the classroom to accommodate growth or variations in individual class sizes.

Generally, larger classrooms are preferable to smaller ones, especially in elementary schools. Elementary-age students need to sit either at individual tables and chairs or at group tables. Project areas are needed within the classroom and typically include areas for science, computer clusters, and other equipment-intensive spaces.

Storage needs within the classroom are often underestimated. Larger classrooms provide greater opportunities for built-in or movable equipment to help meet this need. At the elementary school level, cubbies for backpack and coat storage are often provided within the classroom to facilitate the monitoring of students belongings and, particularly in the north, to assist with arrival and departure preparation.

SIZE REQUIREMENTS FOR SPECIAL EDUCATION CLASSROOMS

STATE	REQUIREMENTS
New York	A 770 NSF classroom is sized for a maximum capacity of 12 students, whereas a classroom size of 450 NSF accommodates a maximum capacity of 6 students.
Virginia	Self-contained classrooms for 10 students are sized at 750 NSF.
Florida	Self-contained special education classrooms are sized for 10 students at a range of 90 to 100 NSF per student.

Storage, small project areas, extensive display areas, varied floor surfaces, and other features are important design elements. Whiting Athletic Complex, Whiting, Indiana. Fanning/Howey Associates.

The Planning Process Step by Step

Each school district is unique and will require an equally unique approach to creating a "space" programming process for determining and implementing the needs for a school building improvement program.

Whether involving new construction or renovation and modernization of existing facilities, project requirements must be fully defined. Many larger districts have facility departments that will provide the design team with the project's requirements. Some

districts will require the development of educational specifications, or *ed specs*. This is an accepted industry term for the document that sets forth the requirements of a specific building program. The Connecticut State Board of Education regulations concerning School Construction Grants, Section 10-287c-1, Definitions, offers a particularly clear and concise definition of this term:

> "Educational Specifications" means a description of the general nature and purpose of the proposed school building project, which may include the applicant's long range educational plan and the relationship of the proposed project to such plan; enrollment data and proposed project capacity; the nature and organization of the educational program; support facilities; space needs; accommodation for educational technology; specialized equipment; and site needs, and any other supporting documents deemed necessary.

The educational specifications are a blueprint, or roadmap, for future improvements or facility design. As such, the contents should be visionary and idealistic. The committee members identified in the following paragraphs should not come with preconceived or limited solution ideas based on past experiences alone, but should instead be prepared to discuss what is needed to meet the educational needs of the district.

Ed specs generally contain information on the type, size, and number of spaces in the project, among other project-related information. Effective ed specs convey more than the numerical parameters of a project; they establish proper guidance for the design team, and will accomplish the following:

- Create a clear and concise document to effectively communicate the scope and needs of the project to the design professional.
- Convey information in such a way as to allow for a creative design solution.
- Set forth the quality expectation of the finished project, including establishing goals for a sustainable solution (e.g., "This project shall be capable of achieving a LEED Silver designation as defined by the requirements set forth by the United States Green Building Corporation [USGBC]…").
- Represent the defined curriculum to be implemented in the facility.
- Account for future changes in use (provide guidance for a *flexible* design solution).
- Limit rigid or fixed descriptions of solutions.
- Ensure development with the complete support of the district's educational professionals and others in the school community.

The term "ed spec" can be misleading if taken literally, as it does not set forth the educational specifications related to curriculum content, nor does it direct teaching methodology. However, a thorough understanding of the district's educational philosophy, objectives, and proposed use of the facility is a basic requirement of a successful ed spec.

In any process involving a broad range of constituents, it is unlikely that all of the participants will agree on every point. Consensus-building is an important part of any planning exercise and should be acknowledged by the entire group at the onset of the process. Consensus for this purpose can be defined as agreement with the proposed direction or outcome of the plan by most of those involved.

Consensus is predicated on the ability of the participants to subjugate their individual "wish list" for the greater cause of developing a workable building solution. If the group can agree to build consensus around ideas and concepts that achieve the prioritized needs of the district, it is possible to reach a solution that will be cost-effective, sustainable, flexible, forward-thinking, and garner the support of the majority of the district's constituents.

Although the specifics may vary, there are seven steps that are common to the majority of successful planning processes. Each planning process should include and address these steps:

1. Assemble the planning committee.
2. Gather data and assess the facility (if an existing building is involved).
3. Workshop 1: Define the opportunity for meeting future educational needs.
4. Generate options.
5. Workshop 2: Validate/evaluate.
6. Workshop 3: Present plans for recommendation and approval.
7. Prioritize and schedule for implementation.

There are a number of variations available within this outline. A general description of each step follows.

Step 1: Assemble the planning committee

Determine who the participants in the process will be. There are a number of constituents who can offer insight and perspective on the use and subsequent solution to a particular facility. The assembled committee can be called a Steering Committee, Facilities Committee, Project Control Committee, or any number of other designations. During this phase, the process is verified, and any subcommittees are assembled that may be required to evaluate specific issues. The size of the overall group varies, but is generally 20–40 people. In general, the committee is made up of any or all of the following:

Board of Education members

Participation by one or more board members can provide valuable insight into district policies and in many districts the board authorizes the services of the architectural/educational planning team and other consultants that may be necessary to fully explore the project. Board members are accountable to the communities they serve and have a vested interest in the recommendations of the committee.

School head, school director, or superintendent

Involvement by the superintendent or other representative of the central administration can provide valuable leadership to the process, help to facilitate communication with other administrators and the board of education, and assist in helping to convey the results of the process to the broader school community.

Working committee of school staff

A representative group of building administrators and classroom teachers can speak on behalf of building users; help to assemble the needs, objectives, and goals of the district; organize the working group; and provide data used in the study. This group is invaluable in supplying the design team with information on building usage.

Architectural/educational planning firm(s)

The consultant team may consist of an architectural firm with programming and

planning expertise, an educational facilities planning firm experienced in programming and planning educational facilities, or both. This team of architects and planners is responsible for providing the professional programming and planning services and is tasked with the overall responsibility to produce the final report. This team should provide leadership during the collaborative process highlighted below. The consultant team serves as adviser on major architectural considerations, such as the evaluation of existing buildings; informs the group of current best practices; and helps resolve differences of opinion among group participants.

Community members

Engaging community members in the process will facilitate a number of goals important to the process:

- Inform the group of the community's perceptions of the district or project. This can be viewed as understanding the district's "brand identity" before beginning the process.
- Convey the needs of the community to the committee.
- Identify community concerns about the project.
- Act as subcommittee members if there is an opportunity to form community partnerships with the district.
- Communicate back to the public as the project progresses.

As these committee members are valued for their roles and thereby gain an increasing ownership stake in the solution, they can become positive spokespersons for the process and the ultimate results.

Student representatives

Overlooked and sometimes underserved voices on planning committees are student representatives. Including three to five students on the committee will provide a perspective not available from any other source. Students are the ultimate end user and will usually be some of the more honest and outspoken members of the committee. It is important to have at least three students so that they do not feel overwhelmed in the context of the larger group.

The committee will be assembled for three to six months and will meet on a regular basis, either semimonthly or monthly. The meetings will involve presentations from the consultant team of architects and planners and from any subcommittee reports developed during the process.

Step 2: Gather data and assess the facility

Assembling information on enrollment, demographics, students served, curriculum, and other information specifically related to the needs and scope of the individual project sets the baseline point of departure in determining facility improvements. If the project involves an existing facility, the team should collect information on building capacity, life safety code compliance, use efficiency, maintenance, building envelope conditions, electrical and technology systems condition, mechanical equipment conditions, and Americans with Disabilities Act (ADA) accessibility compliance. This will provide the steering committee with a broad base of knowledge of the facility and identify required improvements. Deficiencies related to structural, life safety, and deferred maintenance issues will ultimately become

the highest priorities for improvement. During this phase, the process and schedule are verified, the committees and subcommittees are assembled, and responsibilities are assigned.

Step 3: Workshop 1—define the opportunity for meeting future educational needs

With the information collected in Step 2, the first workshop is scheduled. It can be scheduled for three or four hours, an entire day of six or seven hours, or over two days of approximately five hours a day. The time allocated is dependent on a number of factors, including the ability of the district to provide substitute personnel to cover the regular responsibilities of the committee members and the ability of community members to commit the time on a regular basis. During the first workshop, the scope of the project is verified; or if the scope is unknown, parameters are set in place to be used in determining the scope of the project. It is beneficial at this point for the consultant team to give a presentation on the process to be utilized, the parameters of the committee's responsibilities, and trends or practices that will influence the ultimate solution. The committee can offer feedback on a number of topics to help generate the project's opportunities and design challenges. If a longer workshop can be scheduled, it is advisable to have the participants break up into smaller groups of five or six to discuss a variety of issues. After they have had time to adequately discuss the topics given them, a representative of each group will report back to the entire group on their ideas.

For the first workshop, small group topics might include a forward look at the future of the facility being studied, such as:

- What will students be doing in this school 5, 10, and 20 years from now?
- What will teachers be doing in this school 5, 10, and 20 years from now?
- How will the community be using this school 5, 10, and 20 years from now?
- How will technology affect the use of this school 5, 10, and 20 years from now?
- How will this improved facility benefit teachers, students, and the community?

Or, questions could include topics relevant to known concerns about the project, such as:

- What do you believe the major public concerns over this project will be?
- How important is creating a sustainable or "green" building solution?

The workshop, if time allows, could include a charrette to explore the opportunities and limitations of the site, wherein workshop participants have an opportunity to draw their ideas on large sheets of paper.

The result of this workshop is a "design direction statement" to be used by the architectural and planning team in beginning the first program statement, as well as the possible options to be presented at workshop 2.

Step 4: Generate options

The architectural and planning team assesses the information generated from Workshop 1 and develops a draft program statement of needs. Along with this preliminary program, the team generates two to five options for the proposed facility recommendations, develops a list of criteria on which the options

will be evaluated, and prepares a presentation for the committee.

Step 5: Workshop 2—validate/evaluate

The committee is assembled for a second workshop, between three hours and one day long, in which the architectural and planning team presents the options, along with the opportunities and limitations of each. The proposed program document is reviewed to determine if all the needs of the project are being met and if there are issues needing further discussion. The committee works through each one and determines the option (or a new one) that best represents the objectives and goals of the district as established above.

If time allows, small group work by the committee members could include

- Review each option and create a list of comments or recommendations about each.
- Generating a list of pros and cons of each option.
- Comparing the options to the needs identified for students, teachers, and community members.

Step 6: Workshop 3—present for recommendation and approval

The architectural and planning team prepares and presents the draft educational specifications or facilities design guideline to the committee for endorsement. During the workshop, the team will receive any additional comments and assess the ramifications of implementing them. When approved and with any remaining modifications included, the team prepares the final report for presentation to the board of education.

Step 7: Prioritize and schedule for implementation

Depending on the scope of the proposed project work and the agreed-upon services of the architect and planner, the final ed spec is used to potentially establish

- A list of priorities for improvement or implementation.
- A schedule for improvements by phase.
- An order of magnitude cost estimate by phase for consideration by the board of education.
- The sustainability or LEED requirements and their potential impact on schedule, cost, and/or the consultants to be engaged in the project.
- A plan for presentation to the public for finance hearings, bond campaigns, or a referendum, as required in the particular state, to secure financing.

Summary

This is a very general overview of a commonly used process. It is probably not the exact process that will ultimately be used in any individual district. Each project is different, and the process should be designed to meet the particular needs of the school and the community that it serves. At the completion of the planning process, with the financing in place, the project is now ready for the schematic design phase for the entire project or its identified first phase.

EARLY CHILDHOOD AND KINDERGARTEN

Introduction

Kindergarten typically is a child's first introduction to school or a transition from another preschool program—nursery school, Head Start, day care, or any of the many other types of early childhood programs. In most school systems, children enter a program at age 5 or 6, but a growing number of states are mandating early childhood education for younger ages, and it is the stated policy of the administration of Barack Obama to support a significant expansion of these programs.

Kindergarten generally is defined as a form of preschool education in which children are taught through creative play, social contacts, and natural expression. The concept was originated in Germany in 1837 by Fredrich Froebel; kindergarten, "child's garden," was based on the idea that children's play was significant. Froebel employed games, songs, and stories to address the needs of children (at that time, generally ages 3 to 7). The kindergarten served as a transitional stage from home to school, often a child's first formal learning experience. In 1861, American educator Elizabeth Palmer Peabody opened the first kindergartens in the United States, in Boston. By the 1920s, kindergartens were included in public schools in most parts of the United States.

Historically, a child's first day at kindergarten was often his or her first formal learning experience away from home, but today more children have been exposed to other forms of preschool programs or child care. Still, there can be some separation anxiety as the child leaves home and the primary caretaker to transition to a group social environment made up mostly of faces the child does not know. The facility can play a role as the transition zone between where the student is with the person bringing them to school and where they actually enter the school. This transition should be as seamless and comfortable as possible.

Since the early 1950s and 1960s, neighborhood schools, often within a short walk of home, have been replaced by central

▲ *The entire school environment should play a role in the early childhood learning process. Margaret Shadick Cyert Center for Early Education at Carnegie Mellon University, Pittsburgh, Pennsylvania. Perkins Eastman.*

Successful early childhood classrooms require a flexible environment, furniture, and detailing appropriate for small children, as well as extensive storage. Fairfield Early Childhood Development Center, Fairfield, Connecticut. Perkins Eastman. Photograph by Woodruff/Brown.

school districts and complex busing networks to collect children from many neighborhoods. In recent years many school districts began to reverse districting concepts, particularly at the elementary school level, and focus on the creation of community-based schools. Yet there are many districts that still prefer the Princeton Plan, whereby a central school is built for each age group.

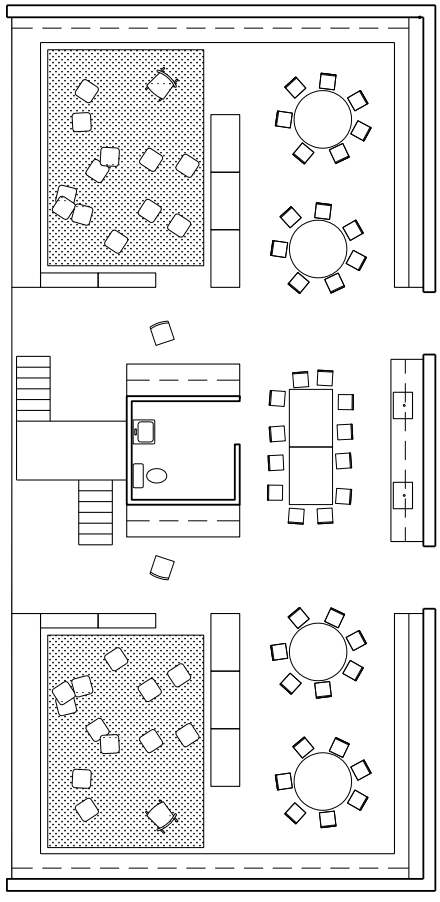
The design of schools for early childhood education has always sought comfortable, supportive, and adaptive settings conducive to a learning process derived from familiar play and hands-on activities. Specific fea-

> The first step of a child's education life must, above all, be an easy one. This means a kindergarten room that welcomes, encourages, and becomes a friend. In design terms, it calls for spaces within the room that are large enough for a wide range of activity, varied and interesting enough to entice the child and hold his attention. The kindergarten should have a generous view of nature…and it should be made easy to enter. (Perkins 1957, pp. 42–44)

tures associated with home, as well as school, are considered in developing an appropriate transitional setting. The type, size, scale, and variety of more public and private spaces underlie appropriate design and planning. Much like a house, containing public spaces (entry hall, living room, dining room, family room) and more private spaces (kitchen, bedrooms, bathrooms), a school should create spaces for comfortable retreat and quiet, reflective play, as well as for small and large group activities. Today, the typical age range of children in kindergarten programs is 4–6 years.

Early childhood programs have attracted many innovators, such as Dr. Maria Montessori, who developed the Montessori method. This is built on the philosophy that children develop and think differently from adults. They are not merely "adults in small bodies." Many schools have been developed over the last century around her ideas that children are capable of self-directed learning. The children are masters of their schoolroom environment, which is designed to be academic, comfortable, and to encourage independence.

Other innovators have also come from Europe. In particular, the early childhood programs developed in Reggio Emilia, Italy, were identified as exemplary in a 1991 *Newsweek* article, "10 Best Schools in the World." This system, which has become one of the most popular international models, is particularly relevant to the subject of this book. In Italy as a whole, preschool programs have been operating for about 35 years, since the enactment of legislation requiring a free education to be accessible to children ages 3–6. This law was followed in 1971 by additional legislation establishing infant/toddler programs.



Early childhood program and kindergarten spaces are typically larger, have some soft flooring for naps, and provide adjacent toilet facilities. Perkins Eastman. Courtesy of Perkins Eastman.

In the community of Reggio Emilia, with some 141,000 inhabitants, results have generated international interest in early childhood education programs. The Reggio approach is built on the creation of conditions for learning that encourage a child's construction of "his or her own powers of thinking through the synthesis of all the expressive, communicative, and cognitive languages" (Edwards et al., 1993).

What makes the Reggio philosophy so appealing to architects and designers, as well as educators, is its reliance on the physical

Like a third teacher, the classroom environment should be stimulating, surprising, and comfortable. Margaret Shadick Cyert Center for Early Education at Carnegie Mellon University, Pittsburgh, Pennsylvania. Perkins Eastman.

environment as a significant contributor to appropriate conditions for learning. The Reggio schools continue to refine the use of every aspect of the environment to stimulate curiosity and support creative learning. The following are key principles of the Reggio Emilia approach:

- *Environment as third teacher*—a belief that children learn from their surroundings as well as the people in their lives so the environment should play an equal role to that of the teacher (parents are considered to be a child's first teacher, and classroom teachers their second). The environment must be flexible and adaptable not only to changing teaching styles, but to individual instructors as well. The environment should at once be stimulating, surprising, comfortable, and familiar. It should allow for small and large group projects as well as intimate spaces for one or two children to explore learning. Classrooms should reflect the students' lives and include display space for projects, artwork, and objects of nature. Common space should be available for art classes and dramatic play and for the gathering of children from different classes in group activities.
- *Emergent curriculum/adaptive environment*—builds on the interests of children. Topics for study are captured from the talk of the children, through community or family events, and from

Collaborative small- and large-group work is an important part of the early childhood learning process. Margaret Shadick Cyert Center for Early Education at Carnegie Mellon University, Pittsburgh, Pennsylvania. Perkins Eastman.

known interests (e.g., puddles, shadows, dinosaurs, etc.). Teachers devise specific projects, provide needed materials, and offer possibilities for parent/community support and involvement. The environment should support the spontaneous development of projects and the needs of planned projects, as well as the demands of changing curricula and educational practices.

- *Multiple forms of representation/exploration*—graphic arts are integrated as tools for cognitive, linguistic, and social development. The presentation of concepts and hypotheses in multiple forms of representation, such as print, art, construction, drama, music, puppetry, and shadow and light play, is essential. The environment should be able to provide impromptu settings as well as the specific equipment, space, or furnishings needed.
- *Collaborative small and large group work*—considered valuable and necessary to advance cognitive development. Children are encouraged to dialogue, critique, compare, negotiate, hypothesize, and problem solve through group activities. Multiple perspectives promote a sense of both group membership and the uniqueness of self.
- *Curriculum child-centered/teacher-framed*—the teacher's role is complex. Teachers are learners alongside the children. They are resources and guides, lending their expertise to the children. They carefully listen, observe, and document the children's work

▲ *Not all learning takes place in the classroom. Tenderloin Community School, San Francisco, California. Photograph by Ethan Kaplan/Esto Photographics.*

and the growth of their classroom community. Teachers are committed to reflection about their own teaching and learning, just as they stimulate thinking and promote peer collaboration among the children.

In the United States the primary source of standards—other than state or local regulatory departments—is the National Association for the Education of Young Children (NAEYC) in Washington, D.C. The NAEYC Early Childhood Program issues the most widely used accreditation standards for programs for centers and schools serving children from birth through kindergarten. These standards, which are often higher than state licensing standards, are, however, voluntary. Among the general goals that all early childhood and kindergarten programs should strive to achieve are the following:

- Create a visually rich, fun, and surprising environment.
- Provide spaces and surfaces for display of children's work.
- Provide a variety of settings for children's works in progress.
- Introduce a variety of social settings for small and large groups.
- Make strong connections between the indoors and the outdoors; above all, use daylighting as much as possible.
- Connect spaces to promote communication, orientation, and flexible programming and staffing.
- Build in flexibility of space to accommodate evolving teaching practices.
- Create a distinctive, pleasing entrance.
- Pay special attention to the scale and height of typical elements such as windows, doors, doorknobs/pulls, sinks, toilets, counters, furnishings, mirrors, steps, shelving/storage, light switches, towel dispensers, and other accessories.

Criteria for High-Quality Early Childhood Programs

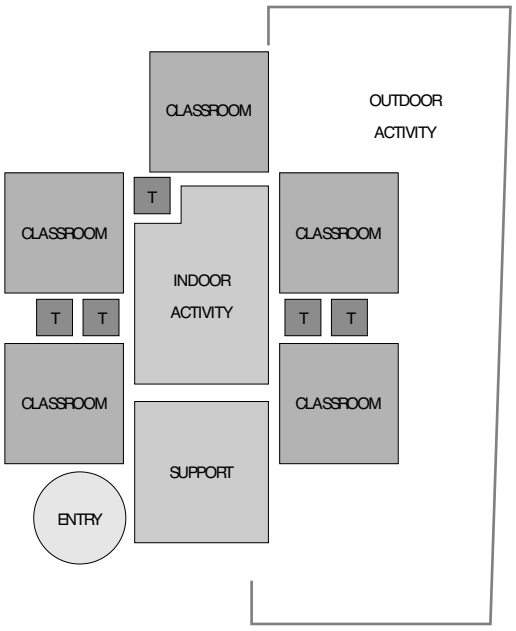
Characteristics of the physical environment:

- The indoor and outdoor environments are safe, clean, attractive, and spacious. There is enough usable space indoors so children are not crowded. There is a *minimum* of 35 sq ft of usable playroom floor space indoors per child and a *minimum* of 75 sq ft of play space outdoors per child. Program staff have access to the designated space

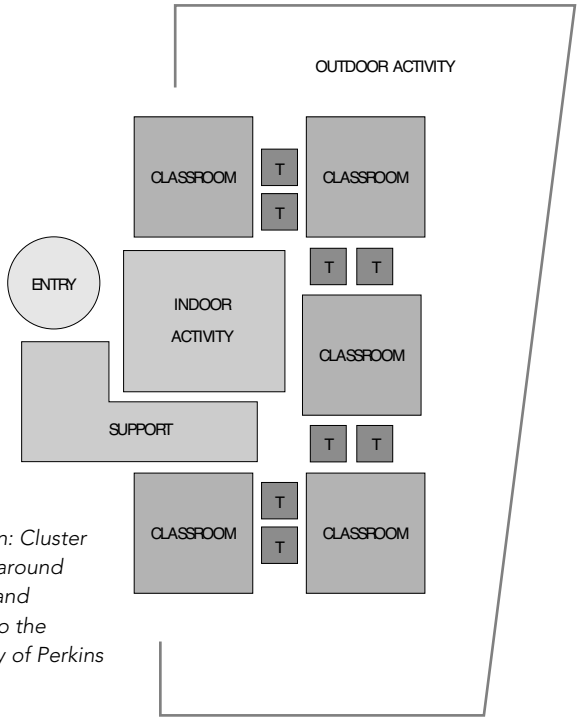
and sufficient time to prepare the environment before children arrive.
- Activity areas are defined clearly by spatial arrangement. Space is arranged so that children can work individually, together in small groups, or in a large group. Space is arranged to provide clear pathways for children to move from one area to another and to minimize distractions.
- The space for children (three years and older) is arranged to facilitate a variety of small-group or individual activities, including block building, sociodramatic play, art, music, science, math, manipulatives, and quiet reading and writing. Other activities, such as sand play and woodworking, are also available on occasion.
- Carpeted spaces as well as hard surfaces, such as wood floors, and ample crawling/toddling areas are provided for infants and young toddlers. Sturdy furniture is provided so nonwalkers can pull themselves up or balance themselves while walking. School-age children are provided separate space arranged to facilitate a variety of age-appropriate activities and permit sustained work on projects.
- Age-appropriate materials and equipment of sufficient quantity, variety, and durability are readily accessible to children and arranged on low, open shelves to promote independent use by children. Materials are rotated and adapted to maintain children's interest.
- Individual spaces are provided for children to store their personal belongings.
- Private areas are available indoors and outdoors so that children can have occasional solitude.
- The environment includes soft elements such as rugs, cushions, or rocking chairs.
- Sound-absorbing materials are used to minimize noise.
- Outdoor areas include a variety of surfaces, such as soil, sand, grass, hills, flat sections, and hard areas for wheel toys. The outdoor area includes shade, open space, digging space, and a variety of equipment for riding, climbing, balancing, and individual play. The outdoor area is protected by fences or by natural barriers from access to streets or other dangers.
- The work environment for staff, including classrooms and staff rooms, is comfortable, well organized, and in good repair. The environment includes a place for adults to take a break or work away from children, an adult-size bathroom, a secure place for staff to store their personal belongings, and an administrative area that is separated from the children's areas for planning or preparing materials.

For projects involving renovation, state guidelines rarely acknowledge the difficulties inherent in adapting older buildings. It is very important to review local building codes for new and renovated projects. Common amendments/issues that should be given special attention include the following:

- Number of exits and travel distance restrictions
- Special emergency lighting requirements
- Number of floors and/or maximum distance above grade
- Types of special locking permitted
- Separations from other uses, if in a mixed-use building or complex



▲ *Plan organization: Cluster model; organized around open play space. Focus is to the interior. Courtesy of Perkins Eastman.*



▶ *Plan organization: Cluster model; organized around common services and corridor. Focus is to the outdoors. Courtesy of Perkins Eastman.*

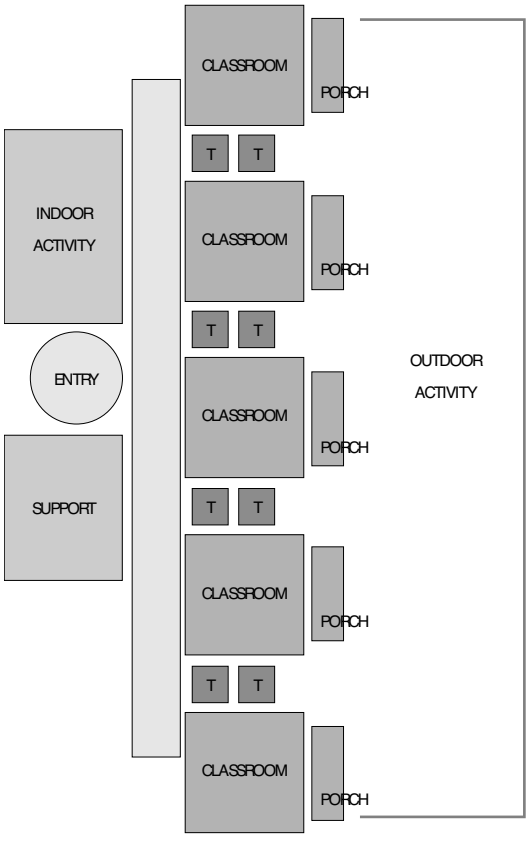
Typical space guidelines are as follows:

- 35–50 usable sq ft/child for indoor activity/classroom space (This area does not typically include staff workspace, administrative offices, storage areas, toilet areas, etc.)
- 75–100 sq ft/child for outdoor activity space

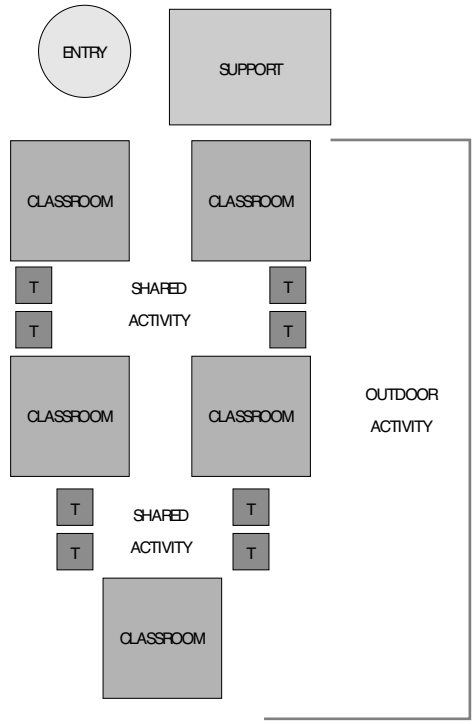
The required space standards often fall short of those recommended by social and behavioral research, in both quantity and arrangement of space. Research also indicates that facilities with too little space (less than 35 usable sq ft of space per child) may lead to more aggressive/destructive behavior, fewer friendly contacts, and less solitary learning and play. Conversely, too much space (more than 50 usable sq ft of space per child) can result in reduced attention spans, more supervision required by staff, and an increase in aimless, random behavior. Thus, some current experts recommend plans such as those shown in the figures on page 29 and above.

Sample program

As mentioned previously, state guidelines for the design and planning of early childhood education and kindergarten facilities provide little insight into the space needs of specific facilities and their design. The table on page 36 shows a sample facility program, assumed for 100 children, and a list of typical spaces and design issues for consideration. With facilities of significantly larger size than shown in this example, consideration



◀ *Plan organization: Linear model; organized along an interior spine. Focus is to the outdoors, with covered porches at each classroom. Courtesy of Perkins Eastman.*



▲ *Plan organization: Hybrid linear; organized along a complex spine made up of a series of activity/play spaces. Courtesy of Perkins Eastman.*

should be given to creating smaller clusters of classrooms organized around shared activities that can be arranged to create a sense of multiple neighborhoods or houses.

Other Considerations

Parking and drop-off

- Review applicable local zoning regulations regarding parking, often based on ratio of spaces to children/staff.
- Adequate drop-off/pickup space at the beginning and end of each day for buses and parents who drive their own children is needed. Consider a long curb pickup lane or short-term loading/unloading spaces at the entrance.
- Adequate lighting at parking and drop-off areas is critical for safety and security.

Entrance

- Welcoming, spacious area with adequate seating and places for informal visiting
- Large enough to accommodate small groups of children and adults
- Often the place where children exhibit the signs of anxiety over separation from parents

SPACES IN SAMPLE KINDERGARTEN FACILITY PROGRAM*

PROGRAM SPACE	AREA (SQ FT)
Entry area	200
Program assistant/reception	120
Administrative assistant's office	120
Director's office	160
Administration copy/supply room	100
Staff workroom/break area/toilet	350
Meeting/parent conference room	200
Quiet room/first aid	100
Kindergarten classrooms (5 @ 800 sq ft each; classroom area includes storage, cubbies, kitchen, etc.)	4,000
Classroom bathrooms (5 @ 80 sq ft each)	400
Central activity/dining area	1,500
Central activity storage	200
Art studio (with kiln)	500
Art studio storage	60
Kitchen/food storage	600
General facility storage	200
Subtotal usable space	8,810
Multiplier for circulation, mechanical area, etc. @ 1.4**	3,524
Total Facility Program (average @ ±123 sq ft/child)	12,334

* Kindergarten program for 100 children
** Assumes ground floor or 1-story space

- Display areas for bulletins/flyers and artwork/children's projects at both adults' and children's eye level
- Close to administrative area to provide security and accommodate parent-teacher/administrator meetings

Corridors/transition spaces

- View as extensions of activity space.
- Avoid long, straight hallways; provide nooks and alcoves for sitting, play, and display and visual connection to classrooms.
- Provide space for wall/ceiling-hung projects, display cases for various art objects.
- Open corridor spaces with interior glass windows looking into adjacent classroom/activity spaces; take advantage of borrowed natural light.

- Avoid designing corridors that have no other use but circulation.
- Use carpeting or other acoustic materials to reduce noise.

Classrooms

- Select materials/finishes to help reduce noise (think in terms of 20 children at active play).
- Create areas for distinct activities (e.g., group meetings, quiet individual concentration, laboratory/semiactive spaces, workshop/studio spaces for art, drama, blocks, games, etc.). These areas are best created through the use of movable furnishings, shelves, bookcases, and so forth, to promote flexibility and the individual character of each classroom. Rectangular spaces are typically easier to configure than square or oddly shaped areas.
- Provide a soft living-room-like area for visiting/relaxing.
- Design space to meet both children's and adults' physical needs. Be sure to provide seating, tables, workspace, and storage suited to both.
- Provide space for cubbies/lockers either between classrooms or within classrooms; allow for adult assistance.
- Provide for display of plants/objects.
- Take advantage of areas below windows for quiet seating nooks or play areas.
- Provide a play area specifically suited to wet or messy activities.
- Include a kitchenette, to serve a group of classrooms or the entire school area, with counters and cabinets at heights for both children and adults; include locking cabinets.
- Provide sinks for both children and adults within the classrooms and near the wet play area.
- If possible, lower sills of windows to 18–24 in. above the floor, to conform to a child's scale.
- Provide ample daylight, with good shade/blind control for nap and quiet activity time.
- Provide flexible lighting levels to accommodate various activity moods.
- Provide bulletin/display boards for children and adults.
- Install an individual temperature control for each classroom.
- Install a child-accessible drinking fountain (can be incorporated with a low sink).
- Provide a toilet room directly adjacent to the classroom; consider special child-accessible fixtures.
- Install hands-free faucets to promote hand washing and general hygiene.
- Provide areas/closets for storage of supplies, games, nap mats/blankets, etc.
- Provide a quiet room/area, possibly shared by adjacent classrooms, for disruptive children or for individual play.
- Balance the need for small, quiet spaces with openness to permit adequate supervision of staff-child interaction.

Administrative space

- Locate near entrance for easy access by families and for view of main entrance.
- Provide administrative offices as required.
- Provide principal's/director's office with adequate space for small meeting table.
- Locate staff mailboxes in or near staff room.
- Provide space for records storage/supplies.

Art studio

- Ample natural light, with good shade/blind control (facing north for indirect light is preferred)

▲ *Art studio with ceramics program. Margaret Shadick Cyert Center for Early Education at Carnegie Mellon University, Pittsburgh, Pennsylvania. Perkins Eastman. Photograph by Jim Schafer.*

- Bulletin boards/display boards/display shelving for children and adults
- Separate kiln room if ceramics work is part of the program
- Large, flat multiuse tables to support individual and group work
- Ample storage for art supplies
- Sensible finishes for easy cleanup after art activities
- Cleanup area within the art studio for both children and adults, with extra-deep clay-trap sinks
- Locking storage cabinets adjacent to sink and counter areas
- A bathroom for children either in the art studio or nearby

Observation/consultation space

(Optional—used for staff teaching and teacher/parent consultations.)

- Position observation space to observe child-child and child-teacher interaction, often within the classroom. (Such spaces are typically provided in early childhood, daycare, and "demonstration school" facilities, usually not in pre-K or kindergarten.)
- Isolate acoustically to allow for discussion of classroom behavior.
- Consider one-way mirrored glass to conceal identity of observers, particularly when parents are included in observer group.
- Consider designing observation space to be shared by classrooms.
- Design may allow for use as quiet activity room if also accessible from classroom.
- Separate lighting control from classroom to support one-way viewing.
- Design for entry/exit without view from observed area.

Kitchen/pantry

- Position for easy/secure delivery access, adjacent to dining area.
- If possible, allow for view from dining area with interior windows to promote child-staff interaction and learning.
- Arrange space to allow for display cooking; try to maintain free sight lines through the kitchen space.
- Provide adequate ventilation.

Communication systems

- Each classroom/area should have a phone and intercom communication.
- Consider locating data outlets within the classrooms to allow for computers/access to the Internet, as well as internal e-mail communication from classroom to classroom.
- Each classroom should have a computer work area.
- Provide multiple electrical outlets in classroom/activity areas for a range of equipment. Consider specifying childproof outlets.
- Provide data outlets at administrative/staff work areas.

Toilet facilities

- Include some child-size toilets, but plan for transition to full-size/adult toilets.
- A preschool bathroom should be directly accessible from the classroom and should be easily supervised by the teacher.
- Provide a minimum of one toilet and sink per classroom.
- Consider hands-free flush/faucet systems to encourage use and promote general hygiene.
- Provide a separate facility for staff and visitors.
- Adapt at least one toilet fixture for accessibility; *do not* use a typical 17 in. high fixture; provide lowered grab bars at a standard 15 in. high fixture.
- Provide locked storage cabinets for cleaning supplies, etc.

Outdoor space

- Direct outdoor access from each classroom is best, or it may be from a central point in the facility.
- Consider sheltering devices against sun, wind, rain, etc.

- Develop different play zones for active group play, quiet individual play, etc.
- Provide bathrooms close to the outdoor play area.
- Use natural land formations/terrain for exploring; trees, rocks, small hills for running, climbing, sliding, etc.
- Allow for good visibility to all areas of the outdoor play space.
- Provide secure boundaries with fencing; try to buffer/soften the appearance of the fencing with plantings.
- Vary surfaces for play—asphalt, concrete, grass, sand, or synthetic recycled interlocking resilient matting beneath climbing/swinging equipment; *avoid gravel*!
- Provide varied outdoor lighting conditions; use shade structures.
- Provide storage space for all outdoor play equipment, accessible from both outside and inside the facility if possible.

▲ *Outdoor activity space should provide for a number of activities. Coman Hill Elementary School, Byram Hills School District, Armonk, New York. Perkins Eastman. Photograph by Paúl Rivera/ArchPhoto.*

Design of the classroom—scale, variety, and flexibility of space. A well-designed classroom environment is safe for children, supports their emotional well-being, stimulates their senses, and challenges their skills. Subdividing the classroom into well-defined "activity pockets" identifies physical spaces that are each functionally limited to one activity, but not completely closed off from the rest of the classroom or from instructor supervision. Observation of preschool children at play suggests that there is a tendency for them to cluster into small groups of less than five, with a mean of about two children. If activity areas are sized for two to five children and an instructor, they should be 40–60 sq ft each. In addition, space should be provided either within the classroom or in a nearby area to allow for an entire class to meet as a single group. The following are simple suggestions for creating activity pockets:

- Care should be taken to allow as much flexibility and adaptability of small activity areas as possible.
- U-shaped or L-shaped low walls can be used to delineate activity areas. The number of activity areas created with permanent walls should be limited, as they can also restrict flexibility.
- Area rugs or other floor finish changes can be used to delineate areas.
- Bookshelves, low bookcases, or other storage and display cabinets can be used to define edges.
- Other furnishings can also be used to define edges, such as the back of a sofa, the edges of reading chairs or comfortable seating, and display systems.
- Existing columns can be used to define edges or corners.
- Ceiling- and floor-level changes can align with centers' boundaries; it is important to consider accessibility to raised platform areas.
- Bay windows, with built-in benches and the addition of other defining elements such as an area rug or low bookcase, can be used for a small activity area.
- Canopies, curtains, latticework, or fabric can be hung from the ceiling to create an activity area.
- Color, lighting, and other material changes can be used to further enhance the articulation of pockets.

All supplies, work surfaces, materials, storage, audiovisual equipment, and required power sources should be provided. Seating and furnishings should adapt to the needs of the activity as well as the size of the group. Finally, there should be an activity area in each classroom that comfortably supports the play of one child as a place for refuge or solitary activity.

Personalization, display, and storage. Providing inventive and creative ways to display the work and projects of the children is essential to support "habitation" of their space. Every part of the architecture should be thought of as potential display space; walls, ceilings, floors, and furnishings throughout the facility should be used. Care should be taken to provide a variety of display spaces for two-dimensional flat work and three-dimensional pottery, mobiles, sculpture, and small crafts. The display area should be flexible and allow for quick and easy change. A display space should be designed for viewing by both adults and children. Appropriate lighting should emphasize the displays and should be adjustable in both position and intensity.

The following are suggestions for display spaces:

- Picture rails or shelves along walls. Particular attention should be given to corridor areas, where walls may become repetitive.
- Closed display cases arranged for viewing from one side or from all sides.
- Open, adjustable shelving.
- Metal gridwork or other mesh materials attached to walls or ceilings to hang artwork/projects.
- Windowsills or areas in front of windows where natural light and the interplay of light and shadow can enhance the objects viewed.
- Other flexible display systems that can be moved or reconfigured to create different desired effects.

Color, pattern, and light. The use of varied colors and textures can be very desirable. A range of textures friendly to a child's skin and body adds another aspect to a child's experience with the physical environment. A number of textures can be considered: wood, ceramic tile, various plaster surfaces, metal or wire screens, fabric, rubber, various metal surfaces, safety mirror, and glass.

Colors can be vibrant or subdued, but there is no need to limit environments designed for children to the ubiquitous primary colors. Research has suggested that bright red hues create excitement, and deep purples and greens are stabilizing and soothing. Yellow, as well as being restful, is the first color that can be perceived by small infants. There are, however, many facilities designed with little or very simple color to provide the most neutral backdrop possible. James Greenman, a nationally respected expert on the design of early childhood settings, advocates this approach because, he believes, the environment should not compete with the artwork and projects of the children. Moreover, it does not overstimulate the children. A neutral background allows the environment to be personalized and animated by its inhabitants. In essence, the space is regarded as an active representation of the children's work and learning process.

Varied lighting not only adds to the interest of the environment, but also provides options for creating moods, supporting different activities, and learning. Daylighting may be a significant part of the education curriculum. Through observation of the sun, children can begin to understand the passage of time, the changing of the seasons, and the movement of the planet. Daylight should be allowed to enter the building from different orientations and locations. Large windows, skylights, and outdoor sundials all help to connect sunlight with the children's daily lives.

ELEMENTARY SCHOOLS

Elementary school classrooms are typically some of the largest in the district, driven by the need for young students to move fluidly from one activity to the next. Students in this age bracket have limited attention spans and are developing a variety of motor skills. The rooms, therefore, need to provide a wide range of activities that can be set up simultaneously. For this section, elementary schools will be defined as including pre-K (age 3) through grade 5.

As noted in the preceding sections, early childhood classrooms, pre-K through grade 2, can sometimes be larger than those for grades 3 through 5. The exact size of the elementary classroom should be a function of the program to be provided; the number

Many new elementary schools have to be built on tight urban sites. Agassiz Elementary School, Cambridge, Massachusetts. HMFH Architects.

Crow Island School is considered by many to be the first modern elementary school. It became the model for the large postwar school building boom. Crow Island School, Winnetka, Illinois. Perkins, Wheeler & Will with Eliel & Eero Saarinen.

AREA 1: ELEMENTARY SCHOOL CLASSROOM SPACE REQUIREMENTS

PROGRAM ELEMENT	COMMONLY REQUIRED	SPACE REQUIRED
Classroom	Yes[1]	Variable; from 700 sq ft in an urban school to more than 1,200 sq ft when land and funds to build larger buildings are not limiting factors.
Computer/ project commons	Yes[2]	350–600 sq ft (one per 100–200 students); should be designed for flexible use, with access to water and storage areas. *Important*: See footnote 2.
Science instruction	Yes	900–1,200 sq ft (one per 300–600 students); size depends on lab type and whether combined as a "wet lab" with art. Wet labs are typically larger (50 sq ft per student) than dry labs or technology-based labs (35 sq ft per student).
Art instruction	Yes[3]	900–1,200 sq ft (one per 300 students); number required depends on program, student population, and grades served. Elementary schools with more than 850 students may require two rooms.

1. Space within the classroom for student cubbies for backpacks and coats if located in a northern climate. Provide ample space for circulation, seating benches, and cubbies sized for today's backpacks, commonly carried by students of virtually all ages.
2. During programming, Computer commons should be carefully evaluated and discussed before committing to this space allocation. With cost-effective computing solutions and new portability, these areas are rapidly converting to project or team space as computers distribute more evenly throughout the school.
3. Art instruction may require space for two-dimensional art such as drawing and painting, three-dimensional art including clay work and model making, and graphic art involving digital photography and photo editing. These three spaces may be interconnected and share certain storage and support functions.

Source: Perkins Eastman.

of students it serves; in-room support spaces such as sinks, cubbies, and toilet facilities; and conformance to state guidelines.

Program Elements

The program elements of an elementary school can be categorized into six areas:

1. *Classroom spaces*: general-purpose classrooms, clusters of classrooms (the "house"—see the following section), labs, art rooms, special education classrooms
2. *Teacher and administrative support areas*: general offices and waiting area, principal's/assistant principal's suite, psychologist's office, nurse's office, conference rooms, common faculty (team teaching) planning and workrooms, faculty dining room, conference rooms, adult toilets.
3. *Media and technology space*: technology center, library/media center, special use/club meeting rooms, exhibition space.
4. *Classroom support space*: gymnasium, cafeteria, specialized resource rooms for remediation.

AREA 2: ELEMENTARY SCHOOL ADMINISTRATIVE AND FACULTY SUPPORT SPACE REQUIREMENTS

PROGRAM ELEMENT	COMMONLY REQUIRED	SPACE REQUIRED
Administrative offices	Yes	120–350 sq ft per office; type and size depend on capacity of the building and the program specifics. Common elements include a principal's office, assistant administrator's office (minimum 1), conference room, nurse's office, administrative support, and reception and waiting area.
Nurse's office/sick bay	Yes	Minimum 350 sq ft, including cot area, restroom, nurse's station, and storage. Located near administrative offices and the main entry; should also have access to athletic fields and multipurpose room.
Guidance/counselor's office	Yes	Number and type dependent on a variety of factors and should be programmed individually for each school. Located near administrative offices with easy access to students.
Staff space	Yes	Minimum 650 sq ft for staff workroom, including kitchenette, work tables, copy area, mailboxes, and material storage.
Storage	Yes	*Note:* The total storage needs of a building are very often underestimated. Storage needs include space for student coats/backpacks, project storage, teachers' resources, building maintenance supplies, book supplies, recycled materials storage (as part of a recycling center), and storage space dedicated to the other major components of the building.

Source: Perkins Eastman.

5. *Performing and visual arts*: art rooms, music rooms, music practice rooms, theaters, auditorium.
6. *Facility management:* central receiving, custodial and maintenance support spaces, recycling room, central storage.

Elementary School Space Guidelines

Elementary schools typically have more basic needs as compared to middle schools and high schools, because a great deal of the instructional program is accommodated in the core classroom. The quantity and type of programs, though, can vary widely, and it is helpful if specialized spaces can accommodate the support of core programs.

The quantity of specialized program areas is determined by the offerings at the school and varies from school to school. The size of each room and quantity of each room type

Elementary classrooms require a space to accommodate special projects such as this one on archeology. Photograph by Judith Perkins.

Art room demonstrating a variety of activities happening simultaneously. American International School: Riyadh, Riyadh, Saudi Arabia. Perkins Eastman. Courtesy of Perkins Eastman.

Carlin Springs Media Center provides for a more relaxed and informal seating gallery. Carlin Springs Elementary School, Arlington, Virginia. Grimm + Parker Architects. Photograph by Kenneth M. Wyner.

AREA 3: ELEMENTARY SCHOOL MEDIA AND TECHNOLOGY SPACE REQUIREMENTS

PROGRAM ELEMENT	COMMONLY REQUIRED	SPACE REQUIRED
Library/media center	Yes	Provide seating for 10% of school population, minimum 50 seats (approximately two classes), plus additional seating for technology access support.
Media center support space	Yes	Determined on an individual basis; could include small group rooms, computer commons/labs, workroom, office, storage, soft/informal seating area, etc.
Technology lab/studio	Optional	Determined on an individual basis; could include small group rooms, computer commons/labs, work room, office, storage, soft/informal seating area, etc.

Source: Perkins Eastman.

AREA 4: ELEMENTARY SCHOOL CLASSROOM SUPPORT SPACE REQUIREMENTS

PROGRAM ELEMENT	COMMONLY REQUIRED	SPACE REQUIRED
Gymnasium/ multipurpose	Yes	Square footage varies; minimum recommended area is 3,200 sq ft for 600 students. Depends heavily on grade configuration and capacity of school. Very large elementary schools may require two of these spaces. For smaller elementary populations, this room may also function as the cafeteria or auditorium.
Cafeteria	Yes[1]	School population ÷ number of planned lunch periods x 13 sq ft. Additional square footage may be required for faculty dining space and individual lunch period scheduling variation.
Media center support space	Yes	Determined on an individual basis; could include small group rooms, computer commons/labs, work room, office, storage, soft/informal seating area, etc.
Exhibit and display space	Optional	Determined on an individual basis; could include art exhibit hall or commons near entry for display of schoolwork.

1. Warming kitchen and full-service kitchen should be planned at up to 40% of the size of dining area, or a minimum of 3.2 sq ft per meal served per shift, including the back counter of the serving areas (5.2 sq ft would be 40% of 13 sq ft; 4.0 sq ft is a good number for preliminary planning). If not serviced by a district's central kitchen, the kitchen would be about 1.5 times this size, or 6 sq ft per seat. Depending on food styles and offerings, the serving line may be up to one-third of the total kitchen NSF. Again, this depends on whether the kitchen is standalone or serviced from a central kitchen. For preliminary planning, 1.5 sq ft per seat should be provided for the serving line. If more demonstration cooking is desired, this area could approach 60% of the total kitchen. *(Notes on Food Service courtesy of Cini-Little.)*

Source: Perkins Eastman.

are functions of the school's total enrollment. The square footage given below for each space can be assumed as a starting point for a 600-student elementary school, grades K–5, with four sections per grade. Areas are subject to variation by program focus and according to increases or decreases in enrollment. For example, for smaller schools, multiple functions can be accommodated in a single space, such as a cafeteria/auditorium or a science/art room. Larger schools will likely require dedicated space to adequately implement the program. Typical program areas for an elementary school are shown in the tables on pages 43–49.

Sample Program

Refer to Appendix A for a sample program for a 750-student rural elementary school in a northern climate. Each programming area should be arranged together as shown.

AREA 5: ELEMENTARY SCHOOL PERFORMING AND VISUAL ARTS SPACE REQUIREMENTS

PROGRAM ELEMENT	COMMONLY REQUIRED	SPACE REQUIRED
Auditorium	Yes	If provided, calculate area required for the main "house" by determining what percentage of the school's population is to be accommodated at one time. For example, (600-student school) x (percentage of students to be accommodated, 50%) x (9 sq ft per student) = 2,700 sq ft. Additional square footage required for stage and support space.
Theater	Optional	Calculate the area for the main "house" as for an auditorium. Additional square footage required for orchestra space, stagecraft, dressing rooms, projection booth, etc.
Theater stage	Optional (if program provides for theater)	1,200–2,400 sq ft; size for largest performance anticipated.
Music rooms	Optional	1,100–1,450 sq ft each; size for largest group using the room. Number required depends on program, student population, and grades served. Elementary schools with more than 850 students may require two rooms.
Art rooms	Optional	Varies; minimum 1,000 sq ft. May include additional space for kiln, storage, etc. Larger elementary schools may require two art rooms.
Exhibit and display space	Optional	Determined on an individual basis–could include art exhibit hall or commons near entry for display of schoolwork.

Source: Perkins Eastman.

AREA 6: ELEMENTARY SCHOOL FACILITY MANAGEMENT SPACE REQUIREMENTS

PROGRAM ELEMENT	COMMONLY REQUIRED	SPACE REQUIRED
Maintenance and receiving space	Yes	Varies; minimum 400 sq ft. Larger if space includes building-wide storage and a recycling center.
Central plant	Optional	Determined on an individual basis; depends on mechanical systems selection, geographic location, etc. Can be programmed as net square footage, or included in gross area if the grossing factors account for it.
Recycling center	Optional	Minimum 400 sq ft; used for separation and collection of recyclables. Located near the shipping and receiving area.
Building-wide storage	Yes	Minimum 400 sq ft; used for maintenance supplies. Can be centrally located or distributed.
Instructional material storage	Yes	Dependent on size of school; provide at least one space of minimum 200 sq ft for book storage, supplemented by other storage areas for teacher resource support. Can be distributed.

Source: Perkins Eastman.

◀ *Another good example of providing students with variety in seating options. P.S. 1/ Bergen School, Robinhood Foundation Library Initiative, Brooklyn, New York. Marpillero Pollak Architects. Photograph by Peter Mauss/Esto Photographics.*

The stage for the multipurpose room at Greenman Elementary School is two-sided, offering an informal stage to the lobby as shown. Amphitheatre seating adjoins the extra-wide stairs leading to the second floor. Greenman Elementary School, Aurora, Illinois. Cordogan Clark & Associates, Inc. Photograph by Ballogg Photography.

MIDDLE SCHOOLS AND HIGH SCHOOLS

Middle school classrooms are more typically aligned with high school classrooms than with those of an elementary school. They may be dedicated for a specific program (e.g., world language or math), or assigned to a number of different programs in a given day or week. Classroom design for middle schools and high schools is similar and treated similarly in this section. Differences are identified and further defined later in the chapter.

Program Elements

The program elements of a middle school and high school can be categorized into seven major areas:

1. *Academic spaces*: general-purpose classrooms, clusters of classrooms (the "house"—see the following section), special education classrooms
2. *Teacher and administrative support areas*: conference rooms, common faculty (team teaching) planning and workrooms, faculty dining room, conference rooms, adult toilets
3. *Media and technology spaces*: technology center, flexible lab space, library/media center.
4. *Community and stakeholder space*: cafeteria, student commons, parent centers, special use/club meeting rooms, exhibition space
5. *Physical education and support space*: Gymnasiums, natatoriums, weight and aerobic rooms, health and fitness centers/classrooms, storage rooms, locker rooms, team rooms
6. *Performing and visual arts*: art rooms, music rooms, music practice rooms, theater, auditorium
7. *Facilities management and custodial space*:

Shipping and receiving, maintenance space, mechanical equipment space, building-wide storage/supply rooms, custodial offices

The preceding list comprises the elements of a middle or high school program. The square footage of the building and incremental sizes of basic program elements will vary greatly from locale to locale. Among the factors that will affect the final program of the middle school are enrollment projections, teaching philosophy, special interests (e.g., athletics, technology, and foreign languages), climate, preferred class sizes, and financial resources.

It is often the financial stability of the school district and not the ability and desire of a community to invest its tax resources that shape the final program. However, most states concur that, at a minimum, the school district must provide the "fundamental instruction spaces" necessary to accommodate enrollment projections. Typically, fundamental instruction spaces include general classrooms, library, and gymnasium spaces.

The program component tables on pages 53–72 address the most common spaces found in middle and high schools but are by no means inclusive of all spaces required. Refer to the sample facilities programs below for a more complete listing of potential spaces.

Space Requirements

As with elementary schools, the quantity and type of specialized program areas can vary widely and are heavily determined by the school's programs and curriculum. As middle and high schools are more specialized than elementary schools, their support spaces are more complex. The discussion of common support spaces in this section includes a general outline and does not address needs for schools of specialized focus, which are discussed later in the chapter.

Academic spaces

Calculating classroom size

General-purpose classrooms usually are designed to accommodate 22–30 students, with the most typical range being between 22–25. The permitted maximum number of students per classroom may vary somewhat from state to state or be influenced by district standards. At both the middle school and high school level, the typical average class size noted above allows for an increase in the student population of 3–5 students per classroom without requiring new construction. In most cases, classrooms should be equipped with 2–4 more seats than the planned capacity to allow for scheduling variations and the occasional larger class.

General classrooms in a middle school, which are typically 770–1,000 NSF, have been based on the guideline of 35 NSF per student for classrooms of 22–30 students. With reductions in the size of technology equipment, the development of more ergonomic and flexible seating, and the availability of other space within the building for specialized break-out space, this guideline is now in question. Where the state or local jurisdiction does not specifically dictate a size, 30 NSF per student is sufficient. Minimum area requirements vary from state to state and must be confirmed by the architect. Some private schools use a smaller average size because of smaller class sizes and/or because they do not have to meet state department of education standards.

Science rooms and labs

Science rooms and labs for middle and high schools range in size between 1,000 sq ft minimum and, occasionally, more than 1,400 sq ft. Many science labs are designed to support individual courses such as biology or chemistry, but they can also be designed as interdisciplinary science spaces. Storage can make the difference between a successful science area design and one that will be perceived as too small. Earth science, for example, requires storage for rocks, soil, microscopes, and so forth; while physics may require a wider range of equipment. Storage and prep rooms for chemistry require chemical storage complete with a preparation area, corrosion-proof shelving, and a fire-proof chemical storage cabinet. Storage areas, both in adjacent spaces and in the classroom or lab, should be provided with locks to protect chemicals and expensive equipment.

Science classroom and lab design should take into consideration three main areas or activities as students engage in lecture settings, hands-on experimentation, and technology use for research, simulation, and measurement of experiments. These can be divided into separate spaces or designed to be flexible, multiuse space. It is often desirable to provide an instruction space in which students sit at desks and learn from the teacher's instructions on either a whiteboard or screen, or from a lab station.

Natural gas or propane is typically provided for chemistry, biology, and multiuse labs, but is not as necessary for physics or technology labs. Most labs should be equipped with sinks with hot and cold water, emergency shutoffs, and eye-washing stations.

Fume hoods and special ventilation requirements are often mandated for science rooms and preparation areas or rooms. Durable materials, resistant to chemical and flame damage, should be used for flooring, casework, and countertops.

Designing for flexibility

One of the themes of middle school and high school design is the exploratory nature of its programming. Students at these levels are inquisitive and may take a number of classes to determine if the subject and content interest them. Consequently, flexibility in secondary school classroom design is critical. The size, configuration, and groupings of classrooms are among the planning concepts most important to the success of the increasingly utilized teaming and house methodology.

Demountable partitions may be used between pairs of classrooms but should be carefully placed where they will be used the most. Other keys to flexible design include

- Furniture that can be arranged in a number of different configurations
- Technology access at various points in the room, as well as wireless Internet access
- Digital display technology to allow material to be presented on a number of different subject matters
- Lighting controls to allow multiple levels of illumination
- Visual connections to adjacent space for "pull-out" activities

Flexibility can mean the inclusion of technology centers that are not subject-specific. The same computer lab may accommodate distance learning, interactive foreign

AREA 1: ACADEMIC SPACE REQUIREMENTS FOR MIDDLE SCHOOLS AND HIGH SCHOOLS

PROGRAM ELEMENT	MS REQUIRED	HS REQUIRED	SPACE REQUIRED
Classrooms	Yes	Yes	Size and quantity of classrooms required are described in the text section "Calculating Classroom Size."
Computer labs	No[1]	No[1]	850–1,200 sq ft; if provided, plan as a flexible space that can be reconfigured in the future, or as a technology project lab with more specialized graphics or media capabilities.
Project/ study commons	Probably	Probably	500–1,200 sq ft (for programs that rely on project-based, self-directed activities, provide one for every 150 middle school students, or one for every 100 high school students). Commonly found in schools with an international baccalaureate (I.B.) program.
Small group rooms	Yes	Yes	250–450 sq ft each (minimum 2 rooms); approximate quantities for establishing a baseline: 1 for every 4–6 general middle school or high school classrooms; number required depends on program, student population, and grades served.
Science spaces	Yes	Yes	1,050–1,450 sq ft (per 125–200 students); size depends on lab type. Wet labs are typically larger (50 sq ft per student) than dry labs or technology-based labs (35 sq ft per student). A combination of both is generally required. Number required is dependent on science course-taking patterns and requirements, types of science classes offered, and utilization goals of the facility. If teachers have their own classrooms, the number required will generally be higher.
Technology/ vocational/ project labs	Optional	Optional	1,050–2,400 sq ft; size depends on lab type. Project labs that are equipment-intensive require a minimum of 50 sq ft per student, less equipment-intensive labs require minimum 35 sq ft per student.

1. Computer labs or commons should be carefully evaluated and discussed before committing to this space allocation. With cost-effective computing solutions, the decentralizing of computer technology, and improved portability and wireless networks to distribute computer access more evenly throughout the school, these areas are rapidly converting to project or team space. Although there may be "computer labs," they are commonly dedicated to a specific function, such as graphic arts, and therefore not labeled as computer labs.

Informal breakout space provides support to the adjacent classrooms. Sunset Ridge Middle School, West Jordan, Utah. VCBO Architecture. Photograph by Dana Sohm, Sohm Photografx.

language studies, language arts, graphic design, and other programs.

Faculty and administrative support areas

The quality of support areas is a significant factor in motivating teachers, fostering a collaborative environment, and facilitating interaction between faculty and students. In addition, a growing body of research has shown that space where teachers can collaborate has tangible benefits for the teaching environment in a school. Administrative areas attract both internal and public visitors. See the table on page 56 for space requirements.

Administration areas should be located adjacent to the main public entrance to enable direct visual supervision of visitors. It is important to provide a reception area for visitors to deter them from wandering through the school unattended. Security has become an ever-increasing concern in school facilities. The inclusion of metal detectors and security cameras is becoming more common. The reception area can act as a control point for the administration area and the school in general.

Private offices should be provided at 100 sq ft minimum for the principal and vice principal(s). The principal's office is often larger to accommodate meetings with students or parents. A second means of ingress/egress for the administrative suite is recommended for security and privacy. A conference room can be a shared facility; if only one is provided, it should be designed to accommodate a minimum of 10 to 15 people at 15 sq ft per person.

In some districts, the superintendent and associated staff (business official, administra-

tive assistants, etc.) may be located in the same area. The same space requirements apply.

Work areas for copiers, fax machines, printers, public announcement systems, faculty mailboxes, and storage should be provided. A vault to secure examinations and petty cash is often included.

The size of the guidance suite will depend on the level of service and requirements as established by the school district and determines the number of guidance counselors, offices, conference rooms, and support spaces required. It is recommended that an area be provided for students to access materials such as information on colleges and other topics of interest. Separate offices for counselors, at a minimum of 120 sq ft per office, should be provided to allow for individual meetings with a student or a student and parents. A conference room is also desirable for somewhat larger gatherings, but may be shared with another area of the school, such as the administration suite.

The nurse/health suite is generally located near, or within, the main offices of the school and close to the physical education area and outdoor play fields. It should also be convenient to a main entry for easy access by EMS personnel. These seemingly contradictory requirements often lead to the design of "satellite" areas, such as a trainer's room, that can be used as a health suite for injuries related to physical education or athletic events. The size of this area will vary greatly depending on the total population of the building. There should be a waiting area for students and staff. A private office directly adjacent to the waiting area should allow direct visual contact for supervision. This office should also have direct visual contact with a "resting room." The resting room should have cots or beds; the number included will depend on the level of service provided by the nurse, but as a general rule there should be one bed or cot for every 200 students. The suite should be equipped with a refrigerator and restroom and should have access to ice.

Dining and food service spaces

The size of the cafeteria/kitchen space varies greatly, depending on the student enrollment, number of scheduled lunch periods, and type of kitchen facilities required. Some school districts require full-service kitchens, whereas others may contract with a food service provider that prepares meals off-site. Whatever the specific situation, it is safe to say that 15 sq ft per person is an adequate size for the purposes of planning the seating area in the initial design; and some schools design to a standard of only 12 sq ft per person.

Kitchen and food service spaces will most likely be more expensive per square foot because of the special equipment required. Particular attention must be given to the mechanical systems, electrical systems, and fire protection of these spaces.

These facilities are often used for activities beyond the cafeteria function. Therefore, the placement of the kitchen, serving areas, and possibly vending machines is critical. It is often desirable to be able to close off the kitchen after lunchtime to allow for other activities. Storage of food products, both dry goods and food requiring freezers and coolers, must be taken into consideration.

Sanitary concerns also affect the design of these facilities. Ease of maintenance and general cleaning of equipment is extremely important. Quarry tile floors and wall bases are often used in the kitchen/cooking area

AREA 2: ADMINISTRATIVE SPACE REQUIREMENTS FOR MIDDLE SCHOOLS AND HIGH SCHOOLS			
PROGRAM ELEMENT	**MS REQUIRED**	**HS REQUIRED**	**SPACE REQUIRED**
Principal's office suite	Yes	Yes	Usually part of an administrative office area located near the building entry; contains at a minimum: 200–400 sq ft waiting area 75–150 sq ft secretary's area 250 sq ft principal's office 200 sq ft assistant principal's office 200–400 sq ft work areas (requirement bsed on school population of 600–800 students, for mail, copying, processing, etc.) 120 sq ft coat and storage 120 sq ft restroom 120 sq ft waiting area
Counselor's office	Yes	Yes	Historically located as part of an administrative office area located near the building entry, guidance and counselor spaces are becoming more centrally located, such as near the library or cafeteria, and contain at a minimum a small waiting area, one or more offices, filing space, access to conference rooms, and restroom facilities.
Faculty offices	Depends	Depends	Depends on the staffing model employed at the school. If staff are to share teaching space, it is common to provide a staff office/workroom. Offices can be either departmental or collaborative (mixed subjects in one office). Offices should be located where students are for passive supervision and ease of access for staff. Minimum size of each should accommodate the largest department's staff, or one-fourth to one-third of the teaching staff at any one time.
Teacher/student/ parent meeting rooms	Probably	Probably	125–450 sq ft each; approximate baseline is 1 per every group of 125 students
Small group rooms	Yes	Yes	250–450 sq ft each; number required depends on program, student population, and grades served. Approximate baseline is 1 per every 4–6 classrooms.
Faculty dining room	Depends	Depends	If not provided, allow enough room in the student cafeteria for teachers to eat with students. If provided, faculty dining space should have a window or serving line directly to the kitchen or servery. Area can be computed by (total population of students) ÷ (number of lunch periods) ÷ (average students per class) x 20 to 25 sq ft per person (allows for a counter with magazines and papers, etc., as well as lounge area if needed; if seating only, 16–18 sq ft is enough). Capacity example for determining the size of a faculty dining room at a 600-student school: 600 students ÷ 3 lunch periods = 200 per seating. 200 ÷ average class size (assume 24) = 8.3 (use 9); teachers minimum x 1.5 for variations in schedule and guests = 13.5 adults; provide adult dining seats for a minimum of 14.
Faculty toilet	Yes	Yes	Provide one male and one female toilet per 125 students (or use larger toilets of two stalls each, male and female, per 250 students); accessible to classroom areas and teacher workroom (or locate inside workroom).
Private phone area (optional)	Yes	Yes	Provide a "phone booth" for staff to make private phone calls, or utilize staff conference rooms by equipping with telephones with outside lines. 32 sq ft minimum if not used as a conference room.
Nurse's suite personnel	Yes	Yes	Accessible to the athletic area and located for easy access in case of emergency

Cafeterias can double as entry commons to increase the size of public space for functions beyond dining. Syracuse High School, Syracuse, Utah. VCBO Architecture. Photograph by Paul Richer, Richer Images.

because these materials are easily cleaned.

The placement of the kitchen within the school building and its relationship to the site require the consideration of at least two factors. Access for the delivery of products and storage facilities for garbage must be conveniently located near the service areas of the kitchen.

Library and media center spaces

The school library/media center is usually a major focal element and often very important to the image of the school. The space requirements for libraries vary greatly, depending on the existing number of volumes and the anticipated growth. The number of stored periodicals and paperback books must also be considered. Books will be important for the foreseeable future, but with the advent of technology-based search engines, the need to browse rows of books will be challenged. High-density shelving may find its way into school library planning as the cost to build and operate space continues to rise and schools seek ways to build more efficient facilities.

The library should include an office for the librarian and a circulation desk, and it often incorporates seminar rooms and small group study rooms. Adequate space should be wired with Internet connections and other technology for research via computers. Some schools incorporate computer labs, teaching/gathering areas for small group instruction, and separate workspaces and private offices.

Visual access to every area of the space by the librarian and staff is important to maintain ongoing supervision. To achieve this, careful placement of the reception area, book stacks, reading areas, and computer areas is critical.

▶▲ *Food courts offering a variety of meal choices reduce the institutional atmosphere of traditional cafeterias. West Brazos Junior High School, Brazoria, Texas. SHW Group, LLP. Photograph by Richard Payne, FAIA.*

AREA 3: STUDENT DINING AND FOOD SERVICE AREA REQUIREMENTS FOR MIDDLE SCHOOLS AND HIGH SCHOOLS

PROGRAM ELEMENT	MS REQUIRED	HS REQUIRED	SPACE REQUIRED
Cafeteria	Yes[1]	Yes[1]	(School population) ÷ (number of planned lunch periods) x (15 sq ft). Additional square footage may be required for faculty dining space and individual lunch period scheduling variations.
Kitchen	Yes[2]	Yes[2]	Warming kitchen and full-service kitchen: up to 40% of dining area NSF; or 3.7 sq ft per meal served, including serving areas.
Food service	Yes[3]	Yes[3]	Depending on food styles and offerings, up to one-third of total kitchen NSF. If more demonstration cooking is desired, this area could approach 60% of total kitchen NSF.

1. As noted, 15 sq ft is a solid planning number for determining the area required per seat. How the actual number of seats is determined may vary based on district policies. Typically, for equal populations of middle school and high school students, there will be fewer high school students participating than middle school students, as there will be a percentage of students who will skip lunch in favor of other activities.
2. It is generally safer to use 4.5 sq ft for high schools, as they generally have slighter bigger portions and more beverages and variety, especially for more diet-related reasons (allergies, etc)
3. Use 2 sq ft per seat basic, and 1.5 times that (or 3 sq ft per seat) if school is not served by a separate central kitchen.

Courtesy of Cini-Little International, Inc.

Media commons like that of the new American International School in Riyadh, shown here, combine state-of-the-art technology with food service in an informal atmosphere. American International School: Riyadh, Riyadh, Saudi Arabia. Perkins Eastman. Courtesy of Perkins Eastman.

Libraries can be wonderful, light-filled spaces, such as the one at Cass Technical High School, Detroit, Michigan. TMP Associates, Inc. Photograph by Balthazar Korab.

AREA 4: LIBRARY AND MEDIA CENTER SPACE REQUIREMENTS FOR MIDDLE SCHOOLS AND HIGH SCHOOLS

PROGRAM ELEMENT	MS REQUIRED	HS REQUIRED	SPACE REQUIRED
Library/media center	Yes	Yes	Provide seating for 10% of school population, minimum 50 seats (approximately two classes) plus additional seating for technology access support. See Media Center section, p.57.
Media center support space	Yes	Yes	Determined on an individual basis; may include small group rooms, computer commons/labs, work room, office, storage, soft/informal seating area, etc.
Media, exhibit and display space	Yes	Yes	Determined on an individual basis; may include art exhibit hall or commons near entry for display of schoolwork.

A variety of seating types helps attract students looking for a more informal reading environment. Saline High School, Saline, Michigan. TMP Associates, Inc. Photograph by Christopher Lark Photography.

Seating should accommodate approximately 10 percent of the school population. This may vary according to the types of seating, number and locations of computer stations, and alternative-use spaces planned. For this 10 percent figure, 25 sq ft per person should be provided. The placement of reading areas of various sizes throughout the library is recommended. This arrangement will make the task of allowing adequate visual supervision from the reception area more difficult, but not impossible. Seating areas may be divided into either class-size groupings, group-size tables, or more informal soft seating for general reading.

Boarding school libraries tend to be much larger than those of public schools because the collections are often much more extensive; however, there is continuing discussion of the role books will play in the future design of school facilities. The library

The library/media center at Roger Ludlowe Middle School, Fairfield, Connecticut. Perkins Eastman. Photograph by Woodruff/Brown.

typically has a distinctive appearance and is prominently located on the campus.

Fitness and wellness spaces

Physical fitness, wellness, and competitive sports are all included in this section. These areas of the schools are often accessible not only during the school day, but also after hours for practice or community use, and as spectator venues for athletic competition.

An official high school basketball court measures 50 ft × 84 ft. A gymnasium used by a middle school can be smaller, but the architect should thoroughly discuss size with the district. If a school participates in competitive athletics, the designer of the gymnasium should verify the size noted above for official court size. These dimensions do not take into consideration the recommended 10–15 ft safety zones behind each main backboard. Bleacher seating is commonly included in middle and high school gymnasiums. The capacity of bleacher seating can be calculated by dividing the length of a bleacher row by 18 linear in. per person and multiplying this figure by the number of rows to be provided.

Careful attention must be given to acoustic and mechanical systems. Because the intended use of the space is for vigorous physical activity and for potentially large

spectator groups, its mechanical requirements usually surpass those of a general-use space. Lighting is critical in such a space, often requiring an increase in footcandles to provide sufficient illumination for sports as well as for potential video filming. Sound systems and sports equipment, such as scoreboards, time clocks, volleyball nets, and the like, will also affect the design of the space.

Larger gymnasiums are often designed to be dividable into two or more sections by means of either a folding wall or a retractable curtain. In these cases special attention must be given to egress requirements, acoustics, and prevention of interference with baskets, exit doors, bleachers, and other fixed elements.

Special provisions must be incorporated for the protection of such equipment as fire alarms and strobes, scoreboards, time clocks, lighting, and speakers. Wire mesh covers can be placed over these items to protect them from basketballs, volleyballs, and the like. Protection of the lighting is particularly important to prevent shattered pieces of glass from showering the floor. Shatterproof protective safety lenses should be provided for all lighting fixtures.

One gymnasium should be provided for every 500 students. Secondary gymnasiums for every additional 500 students or fraction thereof may be smaller, depending on the student population, school policy, and available funding. Smaller gymnasiums allow more flexibility in scheduling classes and constrain classes to smaller groups that are more readily supervised.

▲ *Athletic netting allows larger gymnasiums to be divided into smaller physical education teaching stations without compromising the mechanical systems operation. Chickering Elementary School, Dover Massachusetts. Earl R. Flansburgh + Associates. Photograph by Peter Vanderwarker.*

Other physical education and support spaces

Swimming pools, sometimes referred to as natatoriums, are not as common in high schools as gymnasiums and auditoriums, and are even rarer in middle schools. Attention to mechanical and electrical requirements is critical because of the amount of moisture produced by this type of space. Separate mechanical rooms and pool equipment rooms are often required to accommodate the specialized equipment. It is important to choose materials that resist moisture (see also chapter 11 on materials and chapter 8 on mechanical systems).

At minimum, a pool should be 25 yards or meters (depending on the school's standards) × 6–8 ft lanes. The number of lanes

Climbing walls are a popular addition to physical education programs. Lincoln-Sudbury Regional High School, Sudbury, Massachusetts. OMR—The Office of Michael Rosenfeld, Inc., Architects. Photograph by Robert Benson Photography.

is determined by the school district, designer, and project budget. Pressure to provide pools with a 25 m length is increasing. It is now common to see pools built as 25 m in one direction and 25 yd in the other, or with a movable bulkhead to vary the length of the swimming lane.

Locker rooms and shower spaces should be located in close proximity to the gymnasium and pool. Many jurisdictions require the pool deck to be entered through the locker room shower area and may require locker rooms for the pool separate from those used for the gymnasium. Often called "wet" and "dry" locker rooms, this refers to their proximity to the spaces they support.

Design Note:
One of the first areas reduced to save on construction costs is the amount of deck space around the pool. This can create problems, however, as water safety and physical education classes and swim teams find it difficult to use the pool building when not in the water. Try not to reduce the amount of deck space beyond the amount required to accommodate a minimum of two typical classes or swim teams.

The pool at Lyons Township District 204 illustrates the integration of lighting, mechanical, and acoustic components into the overall design. Lyons Township High School–South Campus, Western Springs, Illinois. DLA Architects, Ltd. Photograph by Alexander Romanovsky/DLA Architects, Ltd.

Locker rooms for boys and girls should be located next to or very near each other. This is important for supervision during school-day use and allows supervision for use by a visiting team during athletic competition. If the school district has an extensive sports program, separate facilities for visiting teams or community use may be appropriate.

Adequate space must be provided to avoid tight quarters in these areas. The activity level of students before and after gym classes and sporting events is often increased. A combination of full-length and smaller box-type lockers is recommended to accommodate clothing, shoes and boots, and gym gear. Lockers should be constructed of durable materials such as heavy-gauge metals or plastics. Lockers should have vents, as well as flush-mounted or recessed lock spaces to avoid sharp edges. Locker benches should be permanently mounted to the floor or wall to avoid hazards and ensure adequate aisle space in front of the lockers.

A gymnasium office should be provided that allows for visual supervision of these spaces. Separate offices are often desirable for male and female gym instructors. These offices should also have visual access to the gymnasium areas. Avoid sight-line views from public areas into the locker room through the offices.

Showers can be provided as a large, single shower room, individual stalls, or a combination thereof. Handicapped-accessible facilities must be provided in adequate numbers to meet local codes. Schools are often used as disaster relief centers during local crises; therefore, this use should be considered in regard to its potential impact on any design.

Flooring materials should be durable and comfortable when walked on barefoot. Ceramic tile is often used; however, it is important to consider the slip resistance of

This flexible health sciences lab integrates space for the athletic trainer and school nurse and space for the health sciences programs. American International School: Riyadh, Riyadh, Saudi Arabia. Perkins Eastman. Courtesy of Perkins Eastman.

AREA 5: FITNESS AND WELLNESS SPACES FOR MIDDLE SCHOOLS AND HIGH SCHOOLS

PROGRAM ELEMENT	MS REQUIRED	HS REQUIRED	SPACE REQUIRED
Gymnasium	Yes[1]	Yes[1]	5,800–12,000 sq ft (one teaching station minimum, two preferred). Full-size basketball court, minimum seating, and clearances. Number of health and fitness teaching stations dependent on district program requirements, total population, and other facilities provided, such as swimming pool and fitness rooms. Provide a minimum of one health and fitness teaching station per 200 students.
Locker rooms	Yes	Yes	For both physical education use and team use, the number of lockers provided should be sized for the anticipated use (factors including, how many students use the locker room at one time, do students store gym clothes in the locker room, do teams store uniforms in the locker room, how big is the largest team using the locker room, how many teams use it at once) and by the districts' physical education requirements.
Health classrooms	Yes	Yes	750–1100 sq ft

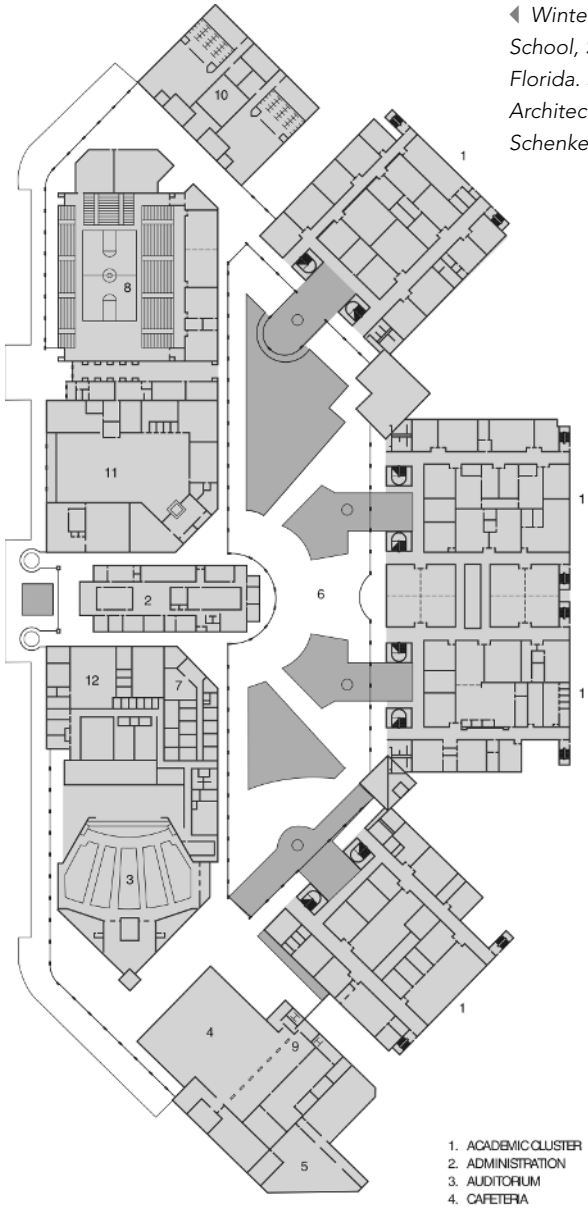
1. Number of gymnasium courts provided is a function of the physical education classes required per day, and the number of team sports and their schedules for practice.

selected materials. These factors should be taken into consideration for wall materials. The designer should be aware of the ease of maintenance for products selected. Surfaces and finishes that are not easily maintained are often not maintained, which can lead to hazardous conditions.

Performing and visual arts spaces

As a general design rule, an auditorium and theater can be categorized as follows: A theater has a large stage and smaller house, while an auditorium has a smaller stage and larger house. This is something of a generalization, but in most cases it holds true. For an auditorium with fixed seating, a guideline of 7–9 sq ft per person may apply, depending on the age group it is designed for and the quality and size of the planned seating. Larger, more padded seats require more space than molded plastic or wood seats. If fixed seating is provided, the space will be dedicated to specific use as an auditorium, lecture hall, and general assembly space for large groups. This type of space will most likely have a stage. The design of a stage varies greatly, depending on the district's needs. A true stage, by definition, has fly space to allow for movable scenery, lighting, and other required equipment; such a stage is generally found in theaters, whereas auditoriums usually have smaller, more open stages or platforms and may or may not have a curtain system.

Sloped floors with fixed seats in auditoriums and theaters will enhance the viewing sight lines. Acoustics, sound equipment, and lighting equipment are critical to the design. General house lighting and special theater lighting are often provided, including a dimmer system for control. For these components, specialists are usually consulted by the design professional.



Winter Springs High School, Seminole County, Florida. Schenkel Shultz Architecture. Courtesy of Schenkel Shultz Architects.

Dedicated auditorium and performance spaces are expensive, but important, parts of a high school. North Harford High School, Pylesville, Maryland. Grimm + Parker Architects. Photograph by Kenneth M. Wyner.

Careful attention must be given to building codes concerning fire protection, seating capacity, and seating placement, as well as aisle widths and lengths. Some auditoriums may include a balcony level, which will entail additional code analysis with respect to egress requirements.

Auditoriums in middle and high schools with flat floors and movable seating are rare but can be used to supplement a facility that also has a theater. This space can provide a district with greater flexibility for presentations and performances as well as allowing reconfiguration for science or art fairs, testing, or even as a secondary banquet facility. These auditoriums often have the same or similar requirements as those with fixed seats—7–9 sq ft per person for auditorium use only. However, as a general design rule, 15 sq ft per person should be used if the space is also used for dining. Flat-floor auditoriums may also be equipped with folding partitions to increase flexibility. Acoustical design is again critical if the space is used for multiple purposes.

A music room can range from the size of a general classroom up to a large multiuse music and orchestra room. One classroom should be provided for every 500 students; size and design are governed by the music program's requirements. Special attention must be given to the acoustics. The use of acoustic wall padding and/or acoustic concrete masonry units is suggested.

Instrumental/band room

As a general rule, the space requirements for this area are 1,400 sq ft minimum; 15 sq ft per person. One such area should be provided for every 500 students. Substantial storage is required for this space, considering the sizes and types of instruments. Daylight is not necessary but recommended. Sometimes

The multiuse cafeteria and auditorium at Carlin Springs Elementary School, Arlington, Virginia. Grimm + Parker Architects. Photograph by Kenneth M. Wyner.

This instrumental music room maximizes natural light and uses curtains to vary the acoustic qualities of the space. Concordia International School, Shanghai, China. Perkins Eastman. Photograph by Tim Griffith.

a tiered floor is desirable. Incorporating this feature will result in a space that is less flexible and will require a greater square footage per student. The placement of this space and the function of adjacent spaces are critical because of the acoustic considerations. Often a separate wing or dedicated area is designated to create a music suite including music classrooms, band rooms, auditorium, choir rooms, and music practice rooms.

Vocal/chorus room

As a general rule, the space requirements for this area are 1,200 sq ft minimum; 7 sq ft per student. One classroom should be provided for every 500 students. The design of this space should follow the same guidelines as for a band room, but less storage is needed for this space. A piano, depending on its size, may increase the required square footage. As in a band room, a tiered floor may be included, again resulting in less flexibility and requiring a greater square footage per student.

Music practice rooms

Music practice rooms vary in size, depending on whether they are used for instrument or vocal practice. As a general rule, the space

AREA 6: PERFORMING AND VISUAL ARTS SPACES FOR MIDDLE SCHOOLS AND HIGH SCHOOLS

PROGRAM ELEMENT	MS REQUIRED	HS REQUIRED	SPACE REQUIRED
Art instruction studio	Yes[1]	Yes[1]	1,050–1,450 sq ft; 1 per 250 students; generally, 2 rooms minimum (number required depends on program, student population, and grades served).
Auditorium	Yes[2]	Yes[2] (if not provided with a theater)	(School population) ÷ (number of planned seatings to accommodate the entire population) x (9 sq ft). Additional square footage required for stage and support space.
Theater[2]	Optional	Optional (if program specifies)	Size of the "house" can be determined by the desired capacity x 9 sq ft. Additional square footage required for orchestra space, stagecraft, dressing rooms, projection booth, etc.
Theater stage	Optional	Yes (if program provides for theater)	2,400 sq ft (minimum stage size for largest performance anticipated)
Music instruction	Yes	Yes	1,100–1,650 sq ft each; for a typical middle or high school of more than 850 students, provide minimum 2 music instructional rooms (number required depends on student population, music and orchestra program, and grades served).
Music practice	Optional	Optional	36–250 sq ft each; number required depends on student population, music and orchestra program, and grades served.

1. Art instruction may require space for two-dimensional art such as drawing and painting, three-dimensional art including clay work and model making, and graphic art involving digital photography and photo editing. These three spaces may be interconnected and share certain storage and support functions.
2. During programming, the needs for an auditorium versus a theater should be determined. As a rule of thumb, an auditorium has a "large house and small stage." Primarily used for presentations, movies; with the correct floor-space flexibility, may be reconfigured for model UN simulation or mock-courtroom experiences. A theater has a "small house and big stage"; usually provided with some form of fly space for scenery, its use is geared more toward performance art of plays, musicals, and recitals, both small and large group.
An example in determining the size of the "house": a 1,200-student high school wants to seat the entire school population in two seatings. 1,200 students total ÷ 2 seatings = 600 seats + 10% for staff and scheduling flexibility = 660 seats.

Outdoor art terrace at Concordia International School, Shanghai, China. Perkins Eastman. Photograph by Tim Griffith.

requirement for a practice room is 25 sq ft minimum. Daylight is not necessary, but increased ventilation for these spaces may be appropriate.

Facility management and support spaces

Adequate storage facilities must be provided to accommodate the mass quantities of reading materials, paper goods, furniture, and other materials and equipment required by a school but not used on a daily basis. The amount of space needed varies from one school to another. Storage areas should be placed throughout the building to allow proper access from areas that will use these facilities; storage room sizes vary according to what will be stored.

All schools require spaces for varying degrees of laundry services, staff lockers, vari-

Design Note:
In designing the mechanical systems for music rooms, be sure to avoid large duct connections between music rooms or between music rooms and other adjacent spaces. Such connections can potentially create a situation where sound will be transferred down the duct, causing considerable distraction in the adjacent room.

ous workshops, and storage for furniture and equipment. Garages may be required to store and maintain the school's maintenance vehicles and the vans or buses used to transport students to athletic and social events, if these are not provided from a separate central location.

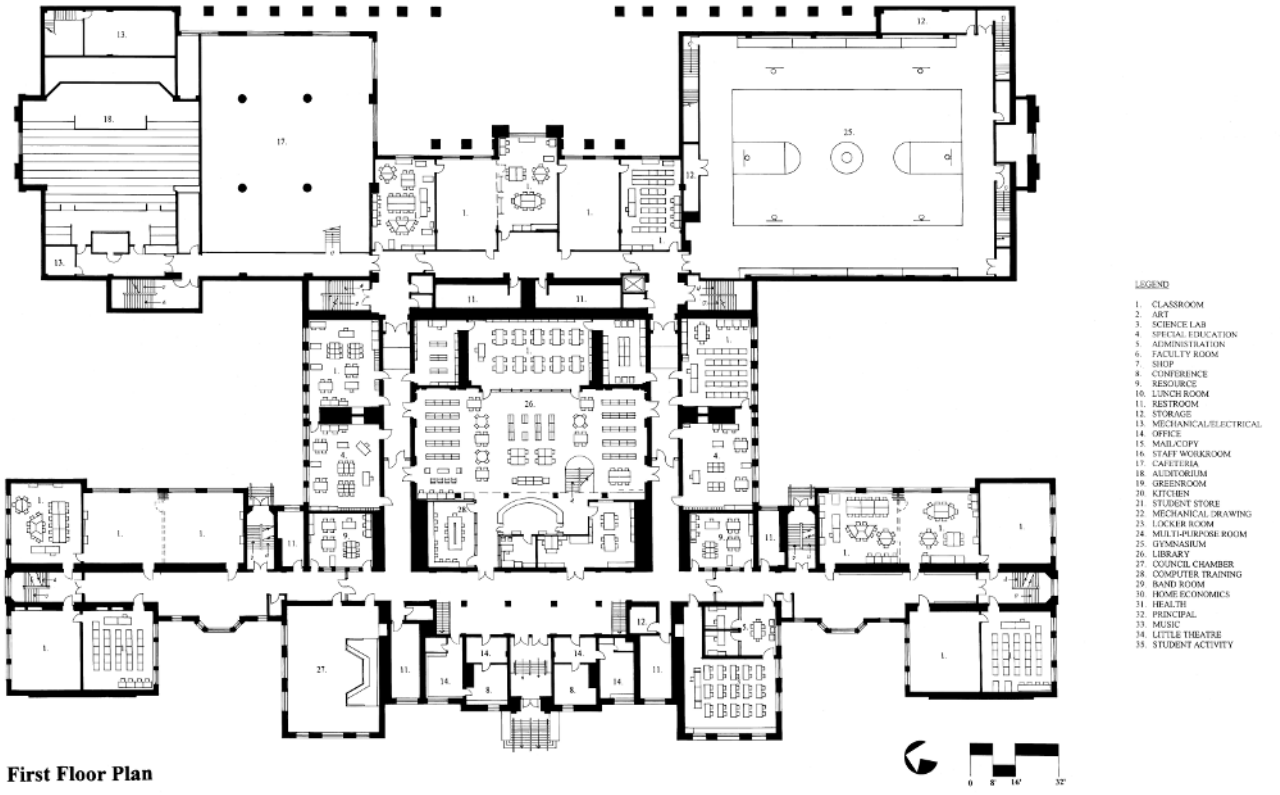
Adequate parking should be provided for faculty, visitors, and staff. Parking for major events like graduation or theater productions may often be handled with overflow lots on lawns and fields to minimize the need for paved areas.

Sample Middle School Facility Space Program

A sample program is shown in Appendix B for a typical 1,200-student suburban middle school in a northern climate. It represents a wide range of potential spaces that might be found in a middle school. Several of the program components are to support an exploratory program and are considered optional depending on the specifics of the program's requirements; these are included in the total student capacity of the building.

AREA 7: FACILITY MANAGEMENT AND SUPPORT SPACES FOR MIDDLE SCHOOLS AND HIGH SCHOOLS

PROGRAM ELEMENT	MS REQUIRED	HS REQUIRED	SPACE REQUIRED
Shipping and receiving	Yes	Yes	300 sq ft minimum; staging requirements of deliveries should be considered. (What other storage areas are provided may determine how long deliveries of paper and other building maintenance supplies will remain in this area.)
Custodial and maintenance offices	Yes	Yes	150 sq ft minimum for one person. Verify program with client if locker or changing areas are required.
Storage areas	Probably	Probably	300 sq ft minimum; storage areas required could include book storage, furniture storage, instructional materials, and maintenance supplies. Verify program with client.
Security office	Verify	Verify	150 sq ft minimum for one person. May include video display terminals for monitoring the schools video security system. May require office space for more than one person, and waiting area or interview room. Verify security personnel requirements with client.
Recycling room	Verify	Verify	250–450 sq ft; many schools provide janitorial and support space for recycling materials from the school's operation. Verify recycling program requirements.
Janitorial and maintenance closets	Yes	Yes	Size, location, and quantity are dependent on the final building design. Maintenance closets to provide for cleaning supply and paper storage, mop storage, and sink.
Telecommunications closets	Yes	Yes	Size, location, and quantity are dependent on the final building design. Provide ample clearance in front of all electrical and communications panels.
Exterior requirements	Yes	Yes	Space should be provided for large trash containers and delivery and service vehicles. Equipment storage may be required for maintenance of buildings and grounds (lawn mowers, field striping machines, rakes, shovels, etc.).



First Floor Plan

▲ *A compact middle school floor plan. Collins Middle School, Salem, Massachusetts. Earl R. Flansburgh + Associates. Courtesy Earl R. Flansburgh + Associates.*

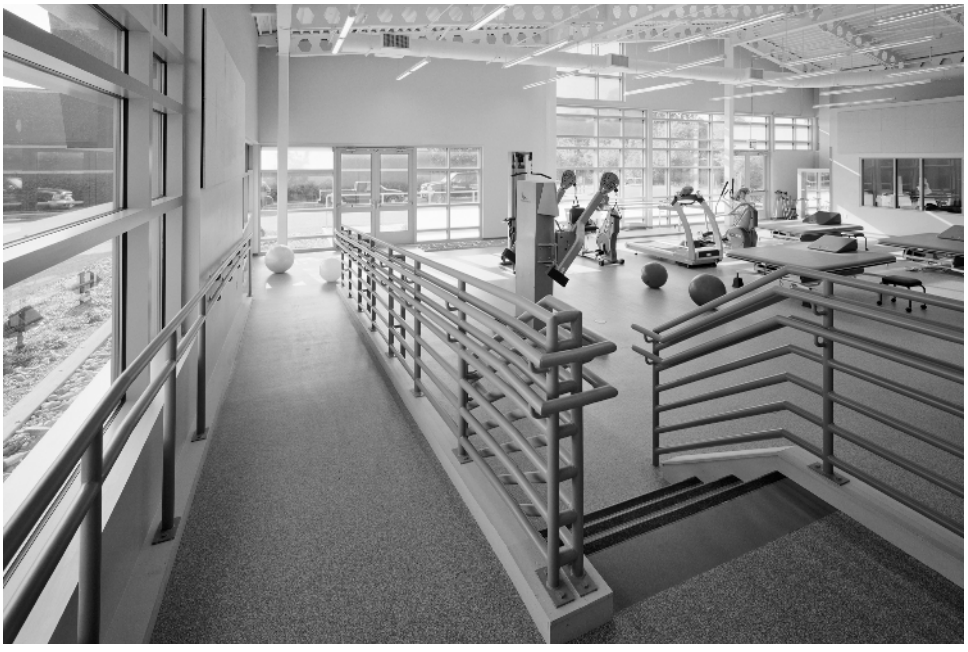
Sample High School Facility Space Program

Appendix C shows a sample program for a typical 1,600-student high school. It represents a suburban school in a northern climate.

SPECIAL SCHOOLS

Today many children with disabilities are "mainstreamed" into general-population schools. These schools, which typically provide rooms for special education in addition to general classrooms, should be handicapped accessible as required by the Americans with Disabilities Act (ADA). However, there is still a need for special schools, and many have been built for both emotionally and physically disabled students. To design these schools, the design team must study and understand these children's special characteristics. There are excellent examples of schools built for children who are blind, deaf, nonambulatory, emotionally disturbed, or with other disabilities. The following are basic points to consider when designing these schools:

- The design team must become extremely knowledgeable of the characteristics of the children's specific disability. Most special



Physical therapy space. UCP Suffolk Diagnostic and Treatment Center, Islip, New York. Perkins Eastman. Photograph by Paúl Rivera/ArchPhoto.

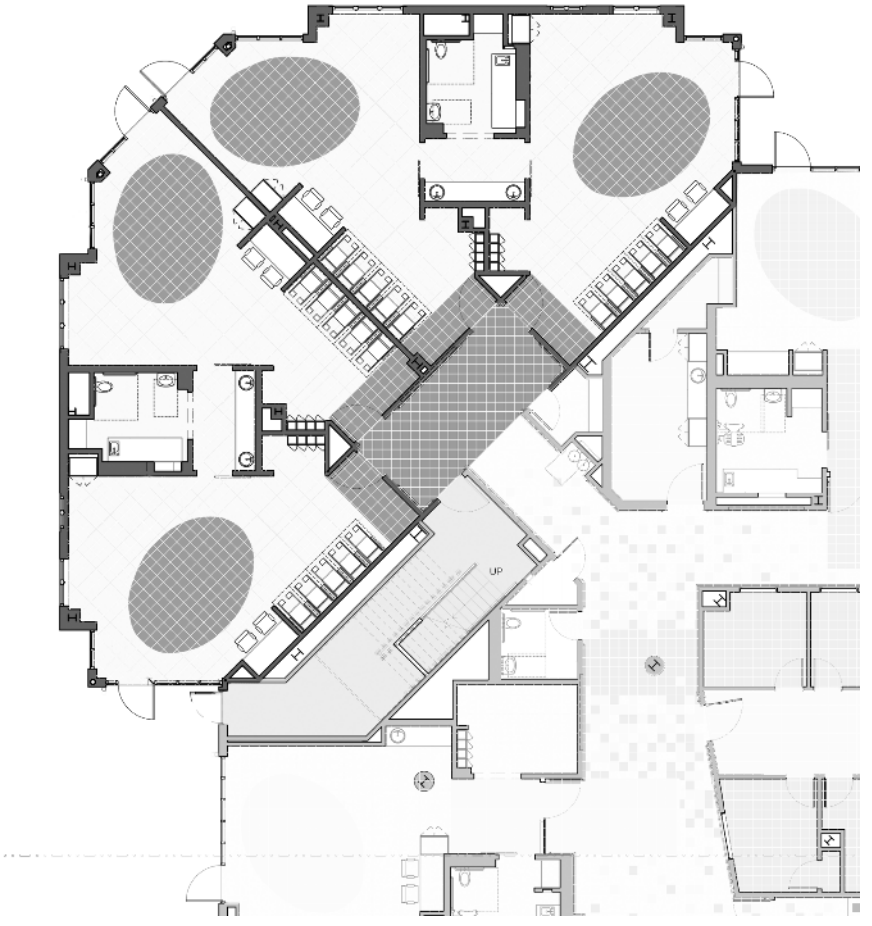
schools require unique and creative design solutions.

- Classrooms in these schools tend to have a lower student-to-teacher ratio.
- Nonambulatory children touch and view their environment and perceive space from a different height than other children. The design should not follow typical standards for mounting heights, windows, and other building elements.
- Toilet rooms should be part of or adjacent to classroom spaces to reduce distance and time without supervision.
- Travel distances to core functions should be minimized.
- Tactile surfaces are important to children who are missing other senses.
- Rooms or spaces, apart from the general classroom, should be provided for working with students one on one.
- Finishes, wall construction, and systems must be designed to withstand unusually heavy maintenance demands.

In addition, there are particular issues that should be considered in each of the more common types of special schools, as described in the following sections.

Schools for Children with Severe Physical Disabilities

United Cerebral Palsy, hospitals for severely disabled children, and other sponsors have created special schools for children with severe or multiple physical disabilities. Most such schools are designed to provide a combination of physical therapy and education that make it possible for the children to return to their families or to be adopted. The basic design considerations include the following:



Classrooms designed for children with multiple disabilities have many special features, including adjacent toilet facilities, soft floor surfaces, and wheelchair storage. Elizabeth Seton Pediatric Center, Yonkers, New York. Perkins Eastman. Courtesy of Perkins Eastman.

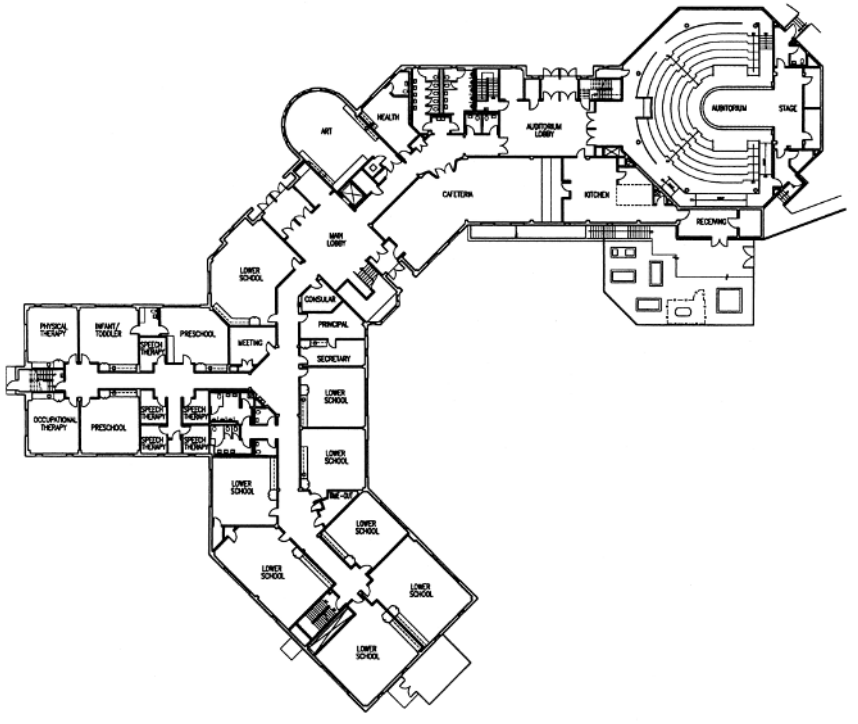
1. Full wheelchair accessibility is essential.
2. Materials and systems should be selected that minimize hazards (sharp corners, exposed heating elements, hard surfaces that can hurt a child in a fall, etc.), floor surfaces should facilitate wheelchair movement, and lighting levels should be sensitive to potential visual impairment.
3. Design flexible classroom spaces, keeping in mind that the children may be seated on the floor. A warm floor, low windowsills, and other special features are appropriate responses to this issue.
4. Class sizes are small, but the rooms must accommodate wheelchairs and a variety of special equipment.
5. Bathrooms should be convenient to all program areas.
6. Outdoor play areas should be designed to facilitate appropriate exercise and play in a very safe setting.
7. All educational environments are typically combined with therapy areas.

The typical classroom at the Coleman School in the New York Foundling Hospital is designed to let severely disabled students sit on the floor. It includes a mirror at eye level, low windowsills, radiant heating, and a flexible layout. Coleman School at New York Foundling Hospital, New York, New York. Perkins Eastman. Photograph by Fred George Photography.

Schools for the Blind and Visually Impaired

There are many specialized schools for blind and visually impaired students, as well as programs in public and private schools for children with this disability. The oldest—and most famous—is the Perkins School for the Blind in Watertown, Massachusetts. Helen Keller (who was both blind and deaf) and her teacher, Annie Sullivan (who was visually impaired), studied there before Helen entered Radcliffe, where she was graduated with honors. Many of the educational concepts for visually impaired children were developed at Perkins and have been adopted in other schools since that time. Among the most important are the following:

1. The term "visually impaired" is used because many so-called blind people have some sight. Therefore, the environment should be planned to maximize students' independence and use of their limited sight.
2. Class sizes tend to be small and are usually set up for flexible teaching using a variety of special teaching aids, toys, and other items requiring storage.
3. Appropriate lighting is very important. Illumination should be planned to pro-



The floor plan for the Mill Neck Manor School for Deaf Children resembles a small community's K–12 school; the differences are in the details. Mill Neck Manor School for Deaf Children, Long Island, New York. Buttrick White and Burtis. Courtesy Buttrick White and Burtis.

vide a high level of even light without glare or similar problems.

4. Contrasting colors and surface texture changes are typical navigational aids. Braille (for elevators and signs) is also used, but a minority of visually impaired students read braille.
5. Low furniture and sharp edges should be avoided.
6. Single-story buildings and carefully graded sites have the obvious advantage of presenting minimal challenges to this student population. Where multistory buildings are used, elevators that call out the floor, stair handrails that are continuous along the landings, and other such details are important.
7. Most schools for visually impaired students include a number of special therapy and training areas to give students the skills to function as independently as possible when they leave the special educational setting. Many children with visual impairment must deal with other disabilities as well.
8. Life safety devices should have clear annunciator features because auditory cues are important to the visually impaired student.

Schools for the Deaf

The most famous educational institution for the deaf is Gallaudet College in Washington, D.C. Like Perkins School for the Blind, it has helped develop educational guidelines for students with certain disabilities. Some

of the more important facility-planning concepts and design details related to these guidelines are the following:

1. As with all good educational environments for children with any disability, class sizes are smaller than in comparable schools. For example, the student: teacher: assistant ratio at the Mill Neck Manor School for Deaf Children on Long Island, New York, is 8:1:1 in a 550 sq ft classroom.
2. The teaching environment should be planned to minimize distracting background noise. Students with partial hearing need quiet. Extra attention should be given to acoustic separation between the corridors and the classrooms. These rooms should be equipped with audio enhancement technology for the teacher. Large spaces, such as an auditorium, are often designed to be acoustically "dead."
3. Lighting levels should be planned to minimize glare or other visual problems, because many students will rely on lip reading, computers, TV monitors, or other techniques and devices to help with their learning.
4. Technology is playing an increasing role.
5. Schools for the deaf also typically include extensive facilities for special therapy, physical therapy, and occupational therapy. This last area focuses on giving students the skills to live independently with their disability.
6. Life safety devices must take hearing disability into account. Flashing lights, for example, are an important part of any alarm system. A closed-caption TV system often serves as the public address system. In addition, the site should be planned to minimize potential student-vehicular conflict, because hearing-impaired persons do not receive many audible warning signals.

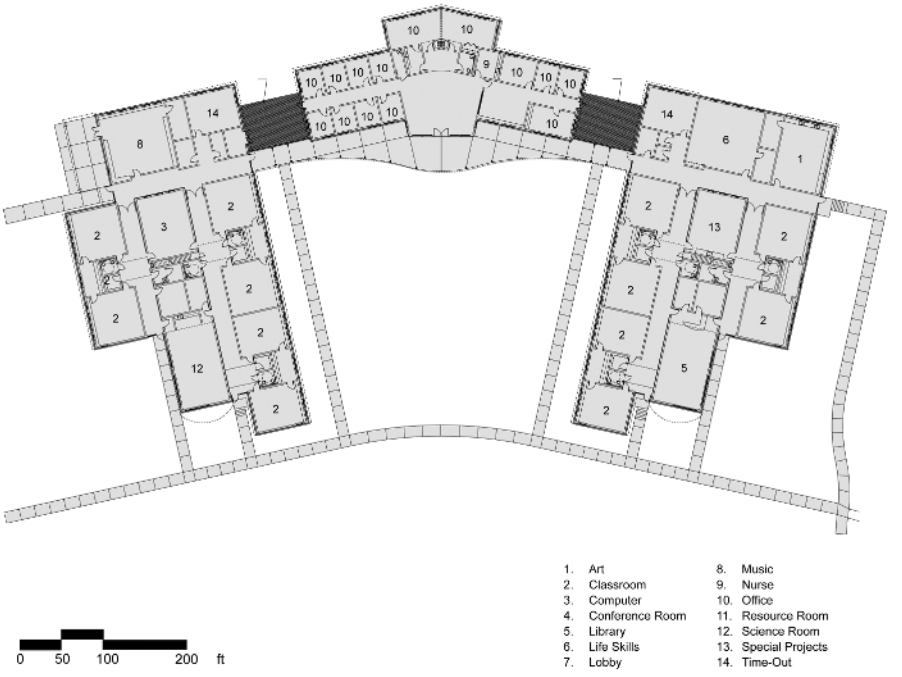
Schools for Emotionally Disturbed Children

There are many schools across the country—some started in the nineteenth century—to provide special environments for children with severe emotional or psychiatric problems. Today many such children are referred to these schools from inner-city neighborhoods and come from families in which drugs or other problems have imposed significant emotional strain. As a result, the many schools developed initially for orphans or other children in need have adapted their programs to serve emotionally disturbed children. Among the key design issues are the following:

1. These facilities typically include supervised housing and mental health and therapy spaces as well as traditional school spaces.
2. The class sizes are typically small and the rooms flexible. Quiet rooms and other features may be part of the program.
3. The facilities must be robust and able to withstand heavy use.
4. Some schools have a special character, such as a farm setting, which is integrated into the program.
5. Some areas may have to have special security features built in, but a non-institutional character is usually a priority.
6. Outdoor activity areas may be a particularly important part of the program.

Vocational Schools

Vocational high schools were a common building type in earlier decades. Their



The design of the new building at the Green Chimneys School for emotionally disturbed children reflects the school's farm theme. Animals are an important part of the children's education and therapy. Green Chimneys School, Brewster, New York. Perkins Eastman. Courtesy Perkins Eastman.

numbers have diminished, but they remain an important educational resource for children who are best served by less academic and more career-specific educational programs.

Vocational schools are most often found today in larger school districts. In most secondary schools, vocational education is a department within the school. The old home economics and shop areas have been replaced with more contemporary trades and occupations, many of them computer aided. While, several trends have made dedicated vocational schools a less popular school type, there is still a need to train a workforce of welders, engine repair specialists, auto body repair specialists, and other trades. At a November 2009 presentation by the Department of Education there was, in fact, an emphasis on "vo-techs" for workforce development in fields such as allied health and computer production.

- The division between industrial and academic skills has eroded. Today's workplace requires more academic skill to deal with technology, and schools include more technology in academic curricula.
- Many vocational courses are now offered at community colleges and by a wide variety of for-profit providers.
- Some vocational programs—such as those providing the technical skills required in science and medicine—require interdisciplinary training.

In general, these trends mean that vocational programs should not be isolated. Instead, they should be integrated into a broader secondary school curriculum.

Selective Academic and Magnet Schools

Selective academic and magnet schools have been created by public school districts for a wide variety of reasons:

- To offer specialized facilities and instruction to gifted children.
- To combine a critical mass of facilities and resources so as to provide a specialized program too costly to be offered in more than one facility.
- To create a school that will attract students from various neighborhoods so as to achieve better racial or geographic balance in a school system.

New York City was one of the first to establish selective academic and magnet schools, including high schools for gifted children: Stuyvesant High School, the Bronx High School of Science, and La Guardia High School of Music and Art and Performing Arts.

Boarding Schools

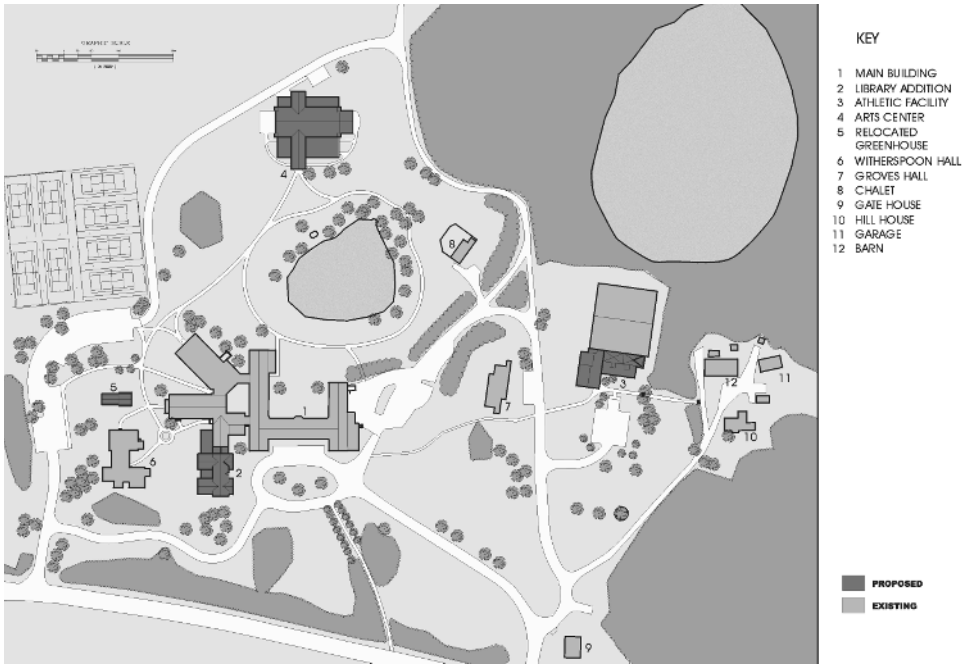
Not counting specialized therapeutic schools, there are more than 290 boarding schools in North America today. These may be coed or single-sex schools and may have a specific focus, such as military, international, or specialized academic schools. Most boarding schools serve children in their high school years, but there are also junior boarding schools for children in elementary and middle school grades. Many are more than 100 years old, located on large campuses with hundreds of acres, elaborate facilities, and distinctive atmospheres.

The planning standards and guidelines for these schools are very different from those of public schools for several reasons. Generally, the curriculum is independent and not subject to state requirements; nevertheless, a school may subscribe to a particular association that requires member schools to meet certain criteria for accreditation. In a boarding school, class size usually is smaller, the curriculum can be more diverse, and there is often a much stronger program of athletics and extracurricular activities. Moreover, the school must provide the elements of a home.

There can be a large disparity between the facilities at different boarding schools. Some may have well-funded facilities that are comparable to those of a small college. Funding for capital projects is typically generated by the alumni through capital campaigns.

Common space standards are nonexistent for boarding schools. Planning for such a facility requires detailed analysis of the mission, history, strengths, and focus of the school. Boarding schools compete with each other for students and teachers. Most fill a particular niche, which makes them attractive to their target markets. The image of the school is very important to both parents and alumni. A strong determinant in assessing programmatic need can be an evaluation of how a school's facilities compare with those of its peer institutions.

As a 24-hour community, the school must also serve as home and extended family to its students. Faculty are often encouraged to live on campus and to eat meals together with the students. The faculty may be instructors during the day, coaches in the afternoon, and monitors on weekends and evenings. There are often extensive community service programs, as well as many weekend and evening activities.



Some boarding schools, such as Miss Hall's, are small campuses with a few buildings, whereas others, such as Philips Academy, resemble small college campuses. Miss Hall's School, Pittsfield, Massachusetts. Perkins Eastman. Courtesy Perkins Eastman.

Housing

Dormitories are often arranged by grade. Most schools prefer a mix of predominantly double rooms with some single rooms.

Common lounge facilities should be located centrally within a building or on each floor. Toilet facilities are typically centralized. Faculty apartments are often included in a dormitory for convenience in providing supervision and counseling.

Some schools wire dorm rooms for technology; others prefer to have students use the school's common computers. The use of laptop computers, the decreasing costs of hardware, and the availability of wireless technologies are causing a shift to access throughout student housing rooms and common areas.

Related facilities include a laundry for linens (sometimes contracted out) as well as coin-operated laundry facilities for students to wash their clothing.

Boarding schools typically include an infirmary, either within one dorm or as a freestanding building. The number of beds and toilet facilities are a function of the school's population, and there is often a residence for the attending nurse.

Incorporating faculty housing on campus is an important goal of many schools. This arrangement aids in retention of faculty and creates a feeling of community and security that is important to students and their families. Typically there is a large home for the head of school that is also used for receptions and special activities, as well as freestanding

Philips Academy, Andover, Massachusetts.

homes for faculty with families, and staff apartments in the dorms or other buildings.

Other boarding school facilities

Theater

Drama production can be a major after-school activity at many schools. Depending on the preference of the school, performances may be given in a theater with fixed seating and a formal stage, or in a black box theater. Provisions should be made for an adequate lobby and support areas such as scenery workshop, prop and costume storage, dressing rooms, and toilets.

Depending on the type of theater, it is often supplemented by a large flat-floor assembly space to gather the student body in one location for morning meetings and dances (often with students from other schools).

Art gallery

Most schools have a gallery or dedicated exhibition space for displaying students' work. Some schools may also have a more formal gallery for traveling exhibitions. Depending on the nature of the gallery, issues of security, climate control, and flexible lighting should be considered. The school gallery should be centrally located and convenient for visitors.

Student center

The student center is a lounge that serves as a place for students to spend time and so-

cialize between classes and on weekends. This space is often furnished with comfortable seating, stereo equipment, a large TV, and games such as pool or board games. It should be centrally located and convenient to classrooms and dormitories.

Dining facilities

Most schools have a centrally located dining room serving three meals a day to students, faculty, and staff. Buffet-style serving lines, rather than table service, are typical for most meals. Many schools want the room to be able to accommodate the entire student body at one sitting. The dining room is often part of the main building and convenient to both dormitories and classrooms. Adequate space should be provided for the servery, kitchen, and support areas.

Administrative and support areas

A boarding school usually has several administration spaces in addition to those found in a typical public school:

- *Development offices*. A school's development office often plays a large part in maintaining alumni relations and raising funds for endowment and capital projects. This department is often located in a separate building on campus.
- *Admissions suite*. The admissions suite is often the first impression for prospective students and their families. It is important to have a space that is prominently located and that creates a good impression of the school.
- *Administration*. The office of the headmaster or headmistress and his or her support staff, the monitors' office, the switchboard, and other administrative functions that deal directly with the students on a daily basis should be centrally located and are often found in the main academic building. The business office component can be more remotely located.
- *Document storage.* Boarding schools often maintain fairly extensive documentation for historical purposes, including transcripts, students' files, old business records, and memorabilia. Dry, heated, secure space should be provided for these collections.

FUTURE SCHOOL FACILITY SPACES

Schools in the future will most certainly continue to reflect the society that they serve. Keeping school facilities relevant and future-proofed will mean creating facilities that

- Are flexible and can be configured to meet changing programmatic or curricular needs.
- Support a variety of learning styles.
- Create opportunities for project-based interdisciplinary work.
- Incorporate ever-changing and complex technology platforms and tools.

This could mean any number of variations and probably means the creation of new space types for schools that will improve their utilization, reduce operational and maintenance costs, and be reconfigurable without major construction renovation. As we move toward designing facilities that reflect a more global approach and curriculum influence, the following pages illustrate some examples of what might be found in the twenty-first century schoolhouse.

The Whole Brain Lab

We hear a lot about people's bent toward left- or right-brain thinking, but few of us often remember which is which. The website www.funderstanding.com explores this topic, making some interesting points well worth exploring further. As it points out, an easy way to remember them is

Left = Logical and Right = Random.

This is why we think of left-brained people as those who are sequential, rational, and analytical and tend to look at the parts of a problem as opposed to the whole. Right-brained people are intuitive, more holistic, and subjective, and look at the big picture over the parts. According to the Funderstanding website, "Most individuals have a distinct preference for one of these styles of thinking. Some, however, are more whole-brained and equally adept at both modes." And here is the important part for planners: "In general, schools tend to favor left-brain modes of thinking, while downplaying the right-brain ones."

The following list represents a studio or suite space concept, intended to provide students and teachers with wide-ranging opportunities to study subject matter through a variety of activities that would support both left- and right-brain approaches to learning. The suite would be capable of being used by one to three classes simultaneously to explore topics in a multidimensional way and using different strategies of comprehension. The suite would be comprised of three main areas:

Exploration Lab: on-line and connected
- Research
- Reading
- Writing
- Collaboration
- Printing
- Production

Investigation Lab: hands-on and real
- Experimentation
- Project based
- Scientific
- Mathematical

Creation Lab: artistic expression
- Drawing
- Two-dimensional
- Three-dimensional
- Model making
- Pottery

The individual areas are visually connected but have the ability to be separated physically. Supported by storage, offices, and prep spaces, this suite of rooms is virtually self-contained, offering the ability to run extended-period programs. These types of spaces are a logical implementation of Howard Gardner's theory of multiple intelligences.

Physical Education and Health Lab

The Centers for Disease Control estimates that the prevalence of overweight children aged 6 to 11 has more than doubled in the past 20 years, and has almost tripled for children aged 12 to 19. For these children, an estimated 61 percent will have at least one additional risk factor for heart disease, such as high cholesterol or high blood pressure.[6] Obviously there is a need for schools to explore new ideas about curriculum, programs, and physical space to deal with

5. http://www.funderstanding.com/right_left_brain.cfm.

these staggering statistics. The lack of an appropriate amount of physical activity can contribute to these statistics and create a number of health risks that include obesity, diabetes, and cardiovascular and other diseases.

Physical education and health-related programs, which focus on teaching the lifelong importance of leading a healthy lifestyle, are gaining in popularity. Each generation continues to live longer than the previous one—partially due, of course, to advancement in medical sciences, but also to our knowledge of maintaining physical health.

Health and wellness suite

The health and wellness suite would be capable of being used by one or more classes simultaneously to explore topics in a hands-on and interdisciplinary environment. Located near the training room, locker rooms, and coaches'/instructors' offices, it would be comprised of three main lab components.

Nutrition and fitness research lab

Workstations provide students with the latest research on health-related nutrition and exercise programs, allowing them to create individualized exercise, diet, and wellness programs. Student can monitor, track, and make adjustments to their individual programs on a weekly basis. Activities conducted in this lab include

- Research
- Writing
- Fitness program design
- Analysis of fitness test results
- Computer simulation
- Nutritional planning
- Results documentation

Physiology lab

Equipped with various aerobic- and anaerobic-type exercise equipment, a weight scale, body mass index (BMI) measurement device, and the like, this portion of the lab is intended for students and faculty to learn about exercise and engage in it; to understand their fitness level and monitor their metabolic changes during exercise. Equipment here can be used in fitness instruction as part of a total program or as a rehabilitation center for students recovering from injuries or surgery. Equipment used to measure breathing and lung capacity might serve as aids in athletic training, or the music department might use it in assisting wind instrument students to improve their conditioning. Activities in this lab include

- Fitness testing
- General exercise instruction
- BMI testing
- Student experiments in conditioning
- Heart rate and stress test monitoring

Testing lab

Lab stations equipped with sinks for simulation and experimentation of health-related science programs. This lab might be used as a forensics lab or for other specialized programs not able to be accommodated in other science classes. Activities in this lab include

- Biology and health-related science experiments, testing, and simulation

6. D. S. Freedman et al., "The Relation of Overweight to Cardiovascular Risk Factors among Children and Adolescents: The Bogalusa Heart Study," *Journal of Pediatrics* 103, no. 6, (1990): 1175–1182.

- Student presentation of work
- Forensic sciences
- Nutritional experimentation
- Foods analysis
- Individual projects and team work projects

The testing lab as outlined above used with other areas of the health and wellness suite, which together try to address the challenges of creating a healthier future for our students. With the majority of the equipment being movable for future changes, the testing lab is built to accommodate a variety of programs.

The ARC—A New Kind of Library

One area of the twenty-first-century schoolhouse that has been pressured to change is the library. Debate is ongoing over books versus digital media, allowing food and drink near books, hours of operation, and the functional value of the library space. There are a number of variations being designed that include several interesting ways to combine space. Some characteristics include

- The inclusion of snack bars (similar to the modern bookstore)
- Larger areas of informal seating
- The use of high-density shelving for the storage of nonfiction books
- Flat-screen displays for collaborative work with presentation and research materials.
- Small group team space
- Self-checkout for print materials
- Printing and copy capabilities

All of these attributes could be supported by supporting the three main functions of the twenty-first-century library: Archives, Research, and Collaboration—or, for short, the ARC.

Archives

This area combines digital and print media resources for access by students and faculty in preparation of lessons, reports, term papers, and homework assignments. It includes periodicals and is supported with both formal and informal seating areas. Books, for the foreseeable future, will still occupy a significant amount of space in the twenty-first-century library; however, they will not all be stored in a "browsing area." Instead, books may be stored and retrieved as needed from lower-cost space, such as temperature- and humidity-controlled basements or storage rooms.

Research

The research area of the ARC provides the furniture and resources necessary for a variety of research modalities, including workstations, conference space/tables, and informal seating, where students might work individually or in groups. There is direct-wired and wireless access to on-line resources, printers, and copy machines, and drop-in terminals are available for student use.

Collaboration

Collaboration can occur in any area of the ARC and is more operational than physical, supported by creating large, flexible spaces and by the use of appropriate furnishings, strong environmental planning, and interior design. The ARC could include a snack bar area and table seating for all-day food service opportunities and could be located near the school's dining facilities. In this way, cafeteria seating may be used for expanded ARC use when not being used for lunch periods.

Conversely, the more formal seating of the ARC located near the snack bar may be used during lunch periods and beyond.

Variable Teaching and Learning "Theaters"

When planning a facility to support a variety of instructional programs, broad user input by faculty, staff, community, and students can offer valuable insight. Typically, "theater" spaces designed for varied programs include an unobstructed performance area with a wood or synthetic floor similar to a theater's stage. It may include a sprung floor, such as those used in dance studios, and state-of-the art sound and lighting systems, and could be supported by back-of-house facilities such as a kitchenette, reception area, dressing rooms, and restrooms. These flexible and multifunction theater classrooms should be located for easy access from inside the building as well as for audience access from outside and they can be configured in a number of different ways.

"Black box" theater

Designed for teaching performing arts of all kinds, a black box theater has a flat floor with movable seating; it accommodates theater in the round, ensemble performances, and films or other video presentations. With black walls and variable acoustics (usually provided by movable curtains), a fixed lighting and sound grid over the entire ceiling, and a sound/projection booth, it is equipped technically for the presentations and performances anticipated. If sized appropriately and with proper protection of its sound and lighting systems, it can even support certain types of athletic activities, such as volleyball, various forms of martial arts, or wrestling. In some instances, the proportions of the theater can be configured to resemble the "stage" of an actual theater.

A typical black box will be between 2,300 and 3,200 sq ft and a minimum of 18 ft in height. At the smaller size, the box should accommodate approximately 150 people, including performers, audience, and staff. A typical performance might have up to 15 performers and accommodate an audience of 130.

"Gray box" theater

An ideal venue for meetings and conferences of all kinds, a gray box is equipped similarly to a black box. With a flat floor and lighter walls (gray perhaps), the space allows a more comfortable venue for tabletop activities with multiple configurations. A gray box may have windows for natural light. It is equipped with sound and lighting systems applicable for the type and scale of the use intended. Somewhat less technical than a black box, this venue is appropriate as a banquet hall, meeting room, or testing center, or for art or science fairs.

"Green box" theater

Similar in design and equipment to the black box described above, this space has a flat floor with movable (portable) seating and accommodates a variety of teaching and performing configurations. The key distinguishing characteristic is the ability to open one wall of the "box" onto an adjacent large room, either a gymnasium or cafeteria, for the purposes of converting it to a "stage" and the adjacent space to a "house" to create a larger theater configuration.

"Blue box" theater

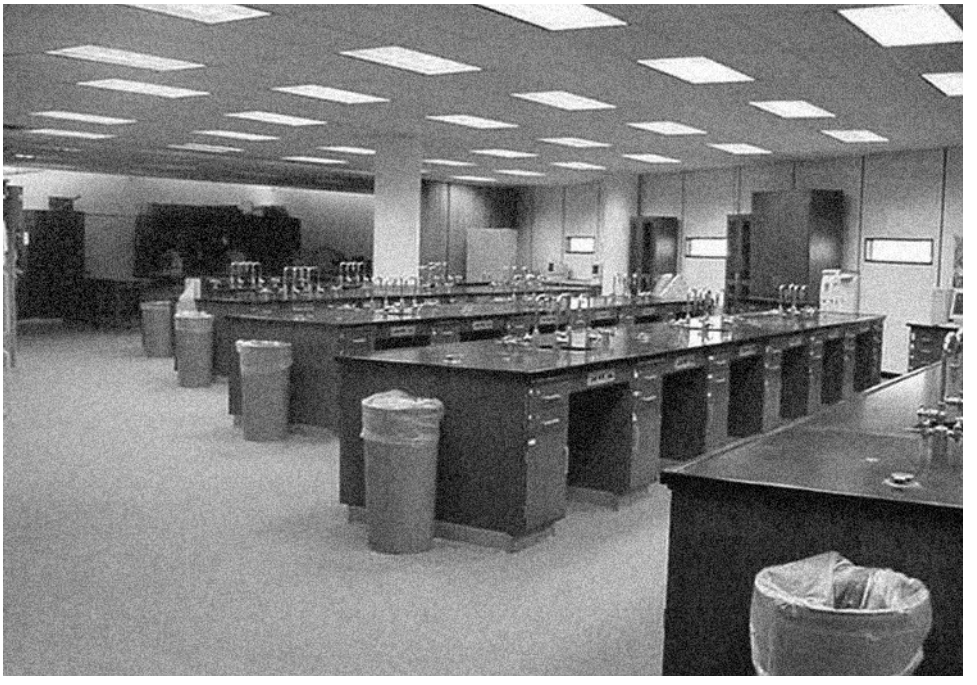
A blue box theater is a performing arts facility that combines the flexibility of a black

The blue box theater at Concordia International School, Shanghai, China. Perkins Eastman. Photograph by Tim Griffith.

box reconfigurable stage area with the acoustics of a recital hall. Somewhat less flexible than black or gray boxes, the room has a sloped floor, fixed seating, and possibly a balcony level. A good example can be seen in the photograph above, showing the blue box theater designed by Perkins Eastman for the Concordia International School in Shanghai. The stage can be reconfigured to support a wide range of spectator participation for performances, team debates of various configurations, mock UN, spelling bees, or chess tournaments, and it is appropriate for any music, drama, or limited athletic event where spectator participation is desired. Seating can range from 130 to 175 or more.

A Case for One Science Lab

The precedent for having a single science lab serve an entire department was established by Mitchell-Giurgola Architects of New York for East High School in Columbus, Indiana. The school, which won an AIA Honor Award in 1975, was designed for an open-classroom curriculum and team teaching. One of the most interesting design features still in use today is the science lab. East High School's science department is unique in that its program is housed in a single large laboratory facility capable of accommodating several science classes in different subject areas at one time. Designed as one large room where physics, chemistry, and bi-



This successful school has a single multistation lab to support its science program. Columbus East High School, Columbus, Indiana. MGA Partners Architects. Photograph by Columbus East High School.

ology students all work on experiments at the same time, this lab is open all day so that students can return to finish a lab or do an extension activity when they choose.

- A large percentage of science instruction is conducted in nonlab space.
- To date, technology space usage has been underplanned in most science labs.
- A single multistation lab would provide higher utilization in less square footage, allowing for higher-quality lab space at the same cost. Following the formula *size x quality = cost,* smaller space and higher quality equals the same cost as larger space and less quality.

There are many other possibilities, and these will become more accepted as school officials, planners, and architects design space to reflect the needs of the program and the students it serves.

CONCLUSION

The type and use of educational technology, availability of increasingly vast amounts of information, and a greater focus on individualized and self-directed instructional models will continue to influence planners and architects in seeking new way of improving the spaces schools build. The ideas represented here are only a sampling of possibilities for new and flexible learning space expected to beome more accepted as school officials, planners and architects, design space to reflect the influences of the twenty-first century.