II. Instructional Environments

New Jersey educators seek to develop prototypes for best practice based on scientifically researched learning environments. Such learning environments are designed to support a range of instructional and assessment activities appropriate to meet the varied needs of learners, staff professional learning and growth, school improvement initiatives, and specific technology applications. They may include:

- Teacher workstations with whole class display capacity (flat panel display or projection device) and control system.
- Individual networked classroom computing devices (desktop, laptop, and handheld – wired and wireless[9]) with task-specific peripherals.
- Individual, portable computing devices for every child, such as text processors, PDAs, graphing calculators, ultraportables, handheld and laptop computers for content-specific activities.
- Classroom computer collaborative learning centers.
- One-to-one computer initiatives.
- Mobile laptop computer labs on recharging carts with wireless network connectivity.
- Instructional technology and vocational laboratories of twelve-to-thirty computer workstations.
- Information and technology resource centers with print and digital content and access to online subscription services.
- Distance/virtual e-learning resources for access to global curriculum.

Teachers and students require sufficient technology resources and systems to engage in authentic learning experiences. To support high levels of learning and efficient instructional management, the following are recommended for consideration in all instructional areas:

- Telephone with access to voicemail for each teacher.
- On-demand access to computing devices (ideally 24/7).
- Robust, consistent, high-speed network access (wired and wireless) to the school, district, and global resources.
- Large flat panel display and/or projection capacity for large-group instruction, collaboration, global communication, and reflection.
- Interactive whiteboards.
- Access to generic (digital cameras) and discipline-specific (digital microscopes) peripheral devices.
- Networked black and white and color printer/scanner/fax capacity.

[9] Each platform – desktop, laptop, etc. - has unique benefits and challenges, which continue to evolve. It is the responsibility of the school technology team to determine the most appropriate selection given the target usage, and to plan for adequate support and maintenance resources.

All students acquire content area knowledge and skills in: (1) Visual and Performing Arts, (2) Comprehensive Health and Physical Education, (3) Language Arts Literacy, (4) Mathematics, (5) Science, (6) Social Studies, (7) World Languages, (8) Educational Technology, Technology Education, Engineering, and Design, and (9) 21st Century Life and Careers. As they do so, they are supported by the ongoing, transparent, and systematic integration of technology from preschool to grade 12 in preparation for postsecondary education and the workplace. [10]

In **Preschool**, technology offers versatile learning tools that can support children's development in all domains. For example, electronic storybooks can "read" stories to children in multiple languages; adventure games foster problem-solving skills; story-making programs encourage literacy and creativity; math-related games can help children count and classify; and science activities promote inquiry and an understanding of the world through the eyes of a child. When preschoolers are encouraged to work together with electronic devices and computers, social skills are tapped as children negotiate turn-taking. However, technology should not replace the concrete, real-life experiences that are critical to a young child's learning. It must always be used in balance with other meaningful activities and routines. Technology should be embedded into children's learning centers and should enhance their learning and development during choice time, as well as in small-group experiences.

In grades **K- 2,** students are formally introduced to the basic features and functions of computers and demonstrate understanding that technology enables them to communicate beyond the classroom on a variety of topics. K-2 students are also exposed to elements of the design process, design systems, and a variety of technology resources, and understand the importance of safety when using technological tools.

In grades **3- 4**, students understand the purpose of and are able to use various computer applications. They continue to develop information-literacy skills and increasingly use technology to communicate with others in support of learning, while also recognizing the need for cyber safety and acceptable use policies. Students in grades 3-4 also investigate the impact of technology systems, understand the design process, and use it for problem-solving.

In grades **5- 8**, students expand their capacity to use operations and applications, apply information-literacy skills, and select the appropriate tools and resources to accomplish a variety of tasks, as they develop digital citizenship. As students participate in online learning communities, collaborating in the design of products that address local and global issues across the curriculum, they build understanding of the perspectives of learners from other countries. Students at this level can apply the design process in the development of products; understand impact constraints, trade-offs, and resource selection; and solve a design challenge and/or build a prototype using the design process. Students can explain why human-designed systems, products, and environments need to be monitored, maintained, and improved, and they recognize the interdependence of subsystems as parts of a system.

In grades **9- 12,** students demonstrate advanced computer operation and application skills by publishing products related to real-world situations (e.g., digital portfolios, digital learning games and simulations), and they understand the impact of unethical use of digital tools. They collaborate adeptly in virtual environments and incorporate global perspectives into problem-solving at home, at school, and in structured learning

[10] 2009 New Jersey Core Curriculum Content Standards for Technology

experiences, with the growing realization that people in the 21st century are interconnected economically, socially, and environmentally and have a shared future.

High School Specialization in technology enables students to design, create, and reverse-engineer technology products or systems, document the application of the design process, and understand its impact—including ethical considerations, costs, trade-offs, risks, benefits, and choice of resources. Students develop products that address local and global issues and challenges, which are disseminated for peer review. [11]

All secondary learning environments must promote skills fostering high levels of learning; engaging higher-order thinking; and encouraging collaboration, teamwork, and a sense of citizenship. The infusion of a diverse array of technology resources throughout secondary school facilities provides the potential to meet the disparate needs of this audience.

In the following sections, space configuration models and the needs of the learners and staff define the technology infrastructure for the various types of spaces in each building. Each building does not always have each model, and some facilities may have multiple types of various space configuration models.

Additionally, the following design criteria are referenced in the New Jersey Schools Development Authority (SDA) *21st Century Schools Design Manual* and have an impact on teaching and learning environments:

- Design Criteria #3. Visual Comfort
- Design Criteria #10. Learning-centered Design
- Design Criteria #12. Accessibility
- Design Criteria #13. Flexibility and Adaptability
- Design Criteria #14. Information Technology
- Design Criteria #23. Community Use

Specific communication, connectivity, teaching and learning resources, and high-speed data access needs are outlined in detail in the following subsections:

A. General Classroom/Instructional Space Configurations
B. Wireless Networks in Support of Teaching and Learning
C. Ubiquitous Computing Strategies
D. Teacher Computing Resources
E. Specialist Areas
F. Special Education
G. School-to-Work and Adult Education
H. Peripheral Devices in Support of Teaching and Learning

[11] 2009 New Jersey Core Curriculum Content Standards for Technology

A. General Classroom/Instructional Space Configurations

Learning environment configurations must match the needs of educators and students and the types of learning or instructional activities that will take place in each setting. For example, schools that currently support a computer lab approach should reconsider the established configurations to determine if they provide effective cooperative learning environments. ***It is important that schools remain in control of local decision- making regarding technology options that reflect the unique needs and goals of the school community and the existing learning environments***. However, information resources or other support from district technical staff in making decisions regarding wiring, Internet drops, computer locations, furniture, or other environmental issues should be readily available. School personnel will need to consider how to deploy appropriate resources (e.g., hardware, software, technology, support services) effectively in order to maximize the benefits of the entire technology system. The equitable distribution of the technology resources throughout the schools will enable all students, teachers, and administrators to function more effectively.

Accessibility and mobility of resources is critical. When called for within the educational technology specifications, teachers should be able to provide on-demand one-to-one student-to-computing resources, as needed. These resources may include desktop and laptop computers, numeric and graphing calculators, handheld computing devices, portable word-processing devices, peripherals such as color printers, scanners, digital still and digital video cameras, and sufficient consumable resources to maximize the potential of these devices. Each classroom should have on-demand access to these resources with minimal difficulty. Additionally, access to the resources alone is not sufficient. High-speed network access to each device, as appropriate, is critical to achieving the maximum learning potential from these resources.

21st Century Classroom

The 21st century classroom incorporates technology-enhanced teaching tools that will dramatically appeal to students. These classrooms include:

- Teacher computers (laptops are generally preferred).
- Student computers.
- Projection/display capacity (projector, flat panel display, interactive digital whiteboard, and/or document camera).
- Speakers for teacher computer and classroom audio enhancement (sometimes supported with voice amplification systems).
- Age-appropriate software.
- On-demand access (24/7) to mobile computing resources and peripherals.
- A combination of movable tables and desks to support both independent and group learning activities.

Sample floorplan drawings for typical classroom spaces are included in Appendix E.

In addition to the standard classroom space, some content areas will require unique configurations, such as science labs and world languages classrooms.

Sample outlet recommendations for classroom spaces and a science laboratory are included in Appendix E.

Computer Lab or Computer Classroom

Computer labs can consist of stationary desktop systems or mobile units comprising laptops in a recharging mobile cart. The computer lab or computer classroom generally provides a one-to-one student-to-computer ratio by locating approximately 15 to 30 networked computers, desktop or laptop, in one instructional area. High-speed network connectivity provides access to printers, Internet and the World Wide Web (WWW), networked media/video resources, library media center resources, digital curriculum and resources, and subscription services, as appropriate.

The desktop computer lab environment is best deployed for the following types of activities:

- Pre-engineering courses that use CAD/CAM applications demanding fast and wide bandwidth, along with the fast processing of high-end workstations.
- Business education courses where the same applications (generally an office suite – word processing, database, spreadsheet, and financial program) are used daily by students in the course.
- Programming, Web design, graphic design, technology certification courses where advanced students may be manipulating operating system configurations and/or computer code.
- Use of Web 2.0 applications that require optimum computer processing speed and Internet bandwidth.
- Video production studio where students are working on individual video productions or animations.

These stationary desktop computer labs are generally hard-wired to the network and provide the computing power necessary for accessing and distributing video and supporting high-capacity computing, such as graphic design, sound recording, and CAD/CAM renderings. Mobile labs use wireless technology to connect to the network, and they can access the Web, share files, and connect to printers. Although wireless bandwidth continues to increase, mobile labs generally do not have the bandwidth to support high volumes of video media.

Mini-labs consisting of 12 to 15 units are generally deployed with laptops and may be both permanent and mobile. For example, many library media centers have a designated teaching area that can be immediately turned into a mini lab by distributing laptop computers and accessing the wireless network in that space. Other specialty areas, such science labs or world languages classrooms, may include full or mini computer labs with 15 to 30 computers, providing one-to-one or two-to-one student-to-computer ratios. Projects and activities focusing on collaboration and cooperation among teams are ideally suited to a two-to-one student-to-computer ratio.

The ability to display a computer screen image to a large group using a projection device is critical to support large-group instruction and collaboration. A ceiling-mounted projection device is generally the preferred projection solution in this environment. As very large flat-panel displays become more affordable, they will present another large-group display strategy. The inclusion of an electronic whiteboard for efficiently capturing and reproducing ideas, diagrams, charts, and other notes should be considered. Some projector/interactive whiteboard combination units may be cost-comparable to traditional ceiling-mounted projector systems once installation costs are included. Likewise, an audio enhancement system may be a feature of this environment.

Although the size and shape of specific instructional areas may dictate the layout of the instructional technology classroom, four of the most common layout options for stationary labs of 30 workstations are:

- Multiple corner clusters
- Multiple hexagon clusters
- Perimeter workstations (with work tables in center)
- Rectangular back-to-back stations

A sample outlet recommendation diagram for a typical computer lab is located in Appendix E.

B. Wireless Networks in Support of Teaching and Learning

School districts are exploring the potential of wireless networking for many reasons. Wireless technology may reduce cabling costs and provide a way for avoiding hazardous materials located in walls and ceilings, as can be found frequently in older facilities. It can be configured to provide service in non-traditional instructional areas such as auditoriums, gyms, cafeterias and exterior areas, provide flexibility in instruction, and bring previously unavailable resources to these various areas, as well as support one-to-one initiatives.

For itinerant teachers who move between buildings or classrooms, wireless networks offer a way to stay connected to the district network from many points on the campus. As computing devices become smaller and more powerful, the vision for effective use of technology in teaching depends on increased mobility and flexibility.

Wireless networks cannot always be considered as an alternative to the wired networks in buildings. Rather, within limitations, it extends the reach of the wired networks and may offer a degree of flexibility and mobility that cannot be otherwise achieved. Security and reliability issues are greater with wireless technologies. For schools considering one-to-one computer initiatives, a wireless network is a necessity.

C. Ubiquitous Computing Strategies

Advances in the portability of computing devices, as size keeps decreasing while performance keeps increasing, the improvement in battery capacity and increased capacity of wireless networking solutions has fueled the growth of mobile computing options and usage. *Please note: throughout the following section a number of commercially available educational computing devices are*

described. This is in no way intended as an endorsement for these specific products, but mentioning them is necessary in order to properly represent the growing field of mobile computing devices and instructional technologies that currently populate schools across the nation. In many cases, these are "one-of-a-kind" devices, although it is expected that it will not be long before similar competing products emerge.

Components

Described throughout this section, mobile computing options range from primary learning tools to fully functional laptop computers. Devices that are readily available on the educational market include:

- Primary learning tools
- Word processing and hybrid computing devices
- Handheld computing devices (handheld computers, graphing calculators)
- Mini-laptop/ultra portable computers
- Laptop and tablet computers
- Cell phones/smart phones

Handheld Learning Aids/Devices

Providing activities in early literacy concepts in reading, mathematics, and English, these engaging devices present information using a multi-sensory, interactive approach that combines seeing, touching, and hearing. These devices include the Leap Frog collection of learning aids: Leapster® Learning Systems, the iQuest® handheld and accompanying content specific cartridges, and the Fly Fusion™ Pentop computer Generally, classroom sets of these learning devices are available for creating on-demand, one-to-one learning in primary- through intermediate-level classrooms.

Handheld Computers

Originally called personal digital assistants (PDAs) and initially used as an electronic address book and calendar, these devices have now earned the label of handheld computers. Available in multiple operating systems, they are compatible with current productivity suites, can be used to send and receive e-mail, connect to full-size keyboards for data entry, and communicate with wireless networks to browse the web. A significant number of education-specific applications are available for these devices. Many school districts are exploring the use of handheld computers with portable keyboard configurations as a low-cost alternative to providing laptop computers to achieve ubiquitous computing.

Portable Writing Devices

Battery-operated, portable writing devices by AlphaSmart® were introduced over ten years ago to provide a low-cost alternative for creating classroom writing laboratories. These devices enable students to easily brainstorm, draft, review, edit, and revise using the writing process. Files can be transferred, via cable or infrared signal, to any application open on the workstation (e.g., word processor, presentation application, and spreadsheet) for manipulation, publication, or printing or posting. Many portable writing devices purchased in the 1990's are

still in use today, as there is no operating system to become obsolete. At most, districts needed to purchase new cables that connected via the universal serial bus (USB) port in place of the original serial port or Apple Desktop Bus (ADB) as classroom computers were refreshed.

Graphing Calculators

Software and peripherals available for graphing calculators and handheld computers are quickly blurring the line between these two learning devices. Mathematical graphing applications allow the handheld computer to graph complex mathematical equations that once could be only done on a graphing calculator. Portable keyboards and word processing software turn today's graphing calculator into a writing tool. Probes, sensors, and meters are available to capture real-time analog data and convert it into digital input for graphing and manipulating.

In the areas of mathematics and science, the use of numeric calculators, graphing calculators, and computer-based labs (CBLs) using different probes and meters for real-world data collection places the student firmly in the role of mathematician, scientist, and explorer of his or her world.

Graphing calculators support algebra, trigonometry, and calculus studies. They allow the student to manipulate and understand otherwise abstract and hard-to-grasp equations and relationships. CBL meters and probes, linked to either a graphing calculator or computer, transform the world of analog information into digital data that can be graphed, charted, manipulated, and studied.

Mini- laptop or Ultra Portable Computers

Mini-laptop, ultra portable or net computers have entered the mainstream marketplace in full force. Development of these small laptop computers with networking capacity was initiated by Nicholas Negroponte's One Laptop Per Child (OLPC) project in an effort to bring computing power and global collaboration to developing nations. The concept motivated major computer manufacturers to develop their own versions of small, light-weight networking devices.

The unifying characteristics of these mini-laptop computers are as follows: 1) small size and light weight, 2) smaller screen (7" to 12" diagonal), 3) robust design to withstand the rigors of student use and travel, 4) flash memory or traditional hard drive for storage, 5) built-in wireless network capacity, and 6) cost effectiveness. Likewise, each of these laptops has unique characteristics that should be matched to local needs. Some of these devices include:

- Acer Aspire® One - http://us.acer.com
- Asus Eee PC - http://eeepc.asus.com
- Dell INSPIRON Mini – www.dell.com
- HP Mini 1000 – http://www.hp.cpm
- Lenovo IdeaPad S Series – http://shop.lenovo.com

Up-to-date detailed specifications and features can be found on each manufacturer's respective Web site.

The impact of these devices on the educational landscape is significant when looking at computing power versus price. Handheld, portable, mobile computing devices are priced so that the feasibility of providing one-to-one computing resources for all students becomes a financial reality for many schools. When selecting computing devices, districts will need to match the purpose and intent of the device with the most appropriate resource as each will have capacity and production limitations.

Laptop Computers and Tablet Computers

Early studies of one-to-one laptop initiatives present compelling evidence of the benefits and potential made possible through the "computer-for-every-child" strategy. Some of the benefits include on-demand access to technology at school and home, increased motivation by students and parents, active parent participation, and enthusiastic teacher commitment to the laptop initiatives.[12]

More recently, data following year one implementation from the state of Maine middle school laptop initiative launched in 2000 showed a significant increase in student attendance and decrease in discipline problems in the grades where the laptops were deployed.

The newest assessment report of the Maine Learning Technology Initiative (MLTI), released in the fall of 2007 revealed:

- Improved scores on writing skills assessment.
- A link to more frequent use and higher scores.
- Writing skills of laptop users transfer to writing without a laptop.

Tablet computers are very similar to a standard laptop with an additional feature that brings significant functionality, a touch-sensitive screen. The screen can be pivoted in multiple directions so that it provides a notepad-like surface with the ability to “capture notes” using a stylus and saves the notes, diagrams and pictures digitally for future reference. A tablet computer connected to a projection device offers teachers and students an effective way to work collaboratively to create easily shareable diagrams, graphics, and other information. Tablet computers continue to be somewhat more costly than standard laptops.

As fully-featured and custom-configured laptop computers become smaller and less expensive to purchase, upgrade, secure, service, and maintain, they become a more realistic integration strategy for K-12 school environments.

D. Teacher Computing Resources

The one technology resource in school districts with the greatest potential for implementing change and helping to create change agents is the computer assigned to the teacher. This computer is assigned to an individual teacher to assist with teaching, learning, and management of daily classroom functions. Whether it is a full-size desktop system or laptop/tablet, the acknowledgment

[12] Rockman, et al. “Report of a Laptop Program Pilot: A Project for Anytime Anywhere Learning by Microsoft Corp. Notebooks for Schools by Toshiba America Information Systems.” Microsoft Corporation Education Download Archive (submitted to Microsoft June 1997): http://www.microsoft.com/education/download/aal/resrch_1.rtf (accessed April 2004).

that educators require tools that are at a minimum equivalent to those used by students is critical to the successful integration of all technology-enriched learning environments.

Teachers need to apply teaching, learning and management skills that make use of diverse strategies, resources, professional development, computers and other digital tools.

This section of the guide discusses the types of teacher resources that are critical to transforming our educators into 21st century teaching and learning leaders.

Instructional Computing Connectivity/Media Control

It is recommended that teachers have a high-speed network outlet near their desk for voice, data, and video. Although most facility designs include broadband video distribution, it is no longer recommended that schools incorporate the use of TV monitors in new construction for large-group viewing. Instead, districts should consider high-lumen ceiling-mounted video projectors, and/or interactive whiteboards, or very large flat-panel displays, as prices continue to drop, that are connected to the teacher computer - desktop or laptop.

An additional strategy found more frequently in new school construction and retrofits is the inclusion of a centralized media control panel that connects the teacher's laptop or desktop to a wide range of video and/or audio teaching resources. The media control panel has a built-in cable TV tuner connected to the school's network, allowing the teacher to view and display to the whole class via the ceiling-mounted or other projector. It also will display video from a VCR, camcorder, DVD player, etc. through the auxiliary audio/video input (S-Video or composite). If attached to a camcorder, the media control panel can enable video conferencing over the Internet. Likewise, an audio enhancement system may be a feature of the teacher environment. Districts are urged to consider designing infrastructure to support centralized media control strategies, even if not deployed initially. A goal of this guide is to help create environments that can respond to future growth and potential.

Teacher Computer

To manage the emerging diversity of today's classroom, the individual teacher configuration should provide video-out and large-group projection capabilities, and built-in high-speed network capacity. This system should be compact enough to travel with the teacher who provides instruction in a variety of classrooms and into the homes of all educators. Access to the school network and global resources allows for flexibility in lesson planning, preparation, resources selection, and reporting.

The teacher workstation area is normally located in proximity to the teacher's desk. The exact location needs to be determined on a room-by-room basis during the design process. Access to voice, video, and data communications should be available at this location, requiring voice, data, and video cable drops. This allows access to a telephone, the Internet, and any video programming distributed throughout the school. The specific quantity of voice/data/AV drops per room should also be determined as part of the design process.

Teacher Workrooms/Faculty Planning Areas

Faculty planning offices and workrooms are recommended within each learning area of the school. Teacher workrooms are areas where teachers can access network and Internet resources for class preparation while meeting with their colleagues or review administrative and/or assessment data. These areas should be planned to allow teachers ample private space, as well as a small-group meeting environment. Therefore, the identification of an area where the workstations can be located is important. The exact location and quantity of workstations will vary depending on the room configuration and local needs.

Some of the technology resources that would be housed in the teacher workrooms or faculty planning offices include:

- Integrated printer/scanner/fax
- Digital still and video cameras
- Wireless and wired network access
- Telephone and facsimile
- Projection capacity
- Laptops, desktops, tablet

The teacher workroom should be sound attenuated to ensure quiet conditions for lesson preparation, personal telephone conferences, etc. The area would be wired for voice and data retrieval and transmittal, and should have enough outlets to provide for the staffs' portable electronic equipment.

Sample outlet configurations for a teacher workroom are included in Appendix E.

E. Specialist Areas: Music, Art, Video Production, Physical Education, Business Education, Technology Education

As implied by their title, "specialist" areas have special and unique needs with respect to both space and technology configurations. The requirements of the music department differ from that of the art department, with both being very different from the realm of physical education, yet, exciting and engaging technology resources are available for each.

This section outlines some of the many resources available to specialist educators that enable them to offer realistic, authentic, creative, and stimulating learning environments in their respective disciplines.

Music

With the incorporation of technology into the music curriculum, students can create new works and study existing pieces. In combination with special composition software, a MIDI keyboard connected to the computer allows students to create spontaneously while the computer records and remembers the details while printers directed by appropriate software can print out the music

annotations. Students may then review their musical composition, revise, and edit as desired with their work being saved to a flash drive, hard drive, or network storage device. Music CD-ROM and DVDs that combine music and graphics allow students to study the music of diverse cultures from all over the world. Applications such as iMovie, iDVD, GarageBand, Photo Story, or MovieMaker matched to distribution channels such as YouTube and iTunes allow budding musicians to record and distribute their musical creations. Storage and bandwidth needs to properly operate these applications must be planned for and met.

Likewise, there are currently a significant number of blogs and Web sites debating the merits and impact of simulations such as Guitar Hero and Rock Band on students learning to play a guitar or create music. Educators should be on the front lines of these dialogs and explorations.

Arts

For the student who never felt like an artist, the use of digital tools in the arts provides a pathway toward creativity through graphic programs that encourage exploration of shapes, colors, patterning, repetition, and recursion. The low cost of color printers adds another dimension to this level of exploration. Specialty software programs allow for cartooning, technical drawing, and combining colors and sounds. DVD resources provide the teacher of fine arts with a venue allowing students to explore the characteristics and trends of individual artists or time periods.

Virtual tours of art museums around the world, the National Gallery of Art in Washington, DC and the Louvre in Paris, being two of the most notable, allow art students to take virtual fieldtrips to study the works of the masters without leaving the classroom. High-speed bandwidth, high resolution projection devices and appropriately powerful computers are necessary to maximize the value of these visual resources

Video Production

The video production configuration enables students to record, edit, and digitally create near commercial-quality video segments. Students can generate commercials, MTV-like music videos, documentaries, and/or short movies. With the addition of video production software to a high-end workstation, students are able to input digital video from camcorders, VCRs, DVD, and other resources, and then output edited and compiled video onto an external monitor/TV for review, critique, and revision. Students electronically publish their work on the Internet and solicit global review and comments.

As in the area of music, common applications such as iMovie, iDVD, Photo Story, Premiere, and MovieMaker matched to distribution channels such as YouTube and iTunes allow students to record and distribute their video productions. Storage and bandwidth requirements to properly operate these applications also must be planned for and met.

Physical Education

Bio-feedback probes and devices connected to a computer allow educators to demonstrate reduced/increased heart rates and stress control, and record subtle

changes over time. Real-time data gathered during these activities in the physical education environment can be evaluated in science and math classes as an interdisciplinary link. Digitized videos of gymnastic moves, football throws, and golf and tennis swings allow students to compare, contrast, and critique their form with that of their peers.

With the rise of childhood and adolescence obesity and diabetes, there is an increased focus at school on health and fitness. Web sites are available to assist students with analyzing their diet and the nutritional quality of the food they eat, then prescribing fitness targets and exercise strategies to reach their goals.

Gaming devices such as the Wii present the opportunity for all schools, even those in urban settings, to offer "virtual sports" environments when campus facilities are not available to support all of these activities. Virtual golf, tennis, bowling, and boxing on the Wii present a similar physical workout as compared to engaging in the "real" sport. Other gaming systems offer activities, such as Dance Dance Revolution, that provide high levels of engaging aerobic exercise.

Business Education

As the typical business workplace has evolved to a technology dependent environment, so has the business education curriculum in secondary schools. The business education curriculum that has been recently revised at the state and district levels includes many of the following tracks (those listed below reflect the NJ draft standard 9.4 D – Business, Management & Administration (http://www.nj.gov/education/cccs/2009/final.htm):

- Administrative Services
- Business Information Technology
- General Management
- Human Resources Management
- Operations Management

Within the vast majority of these programs, students have access to degree and certificate programs and/or courses. Many of these programs are being offered through dual enrollment course partnerships with local community colleges. In an effort to replicate the technologies found in today's business community, many secondary schools incorporate sophisticated office automation and business systems into the curriculum, frequently providing a host of services to community organizations, such as developing business plans or marketing campaigns for small businesses. Secondary schools expecting to graduate students who will become productive citizens of the 21st century need to consider the technology resources and teaching expertise required to simulate a wide variety of real workplace environments, problems, solutions, and collaborations.

Technology Education

Likewise, in an effort to keep abreast of changes dictated by the demands of the 21st century, NJDOE's 2009 content standards in technology education, engineering and design and 21st Century life and careers have also continued to change to address emerging needs within the world of work in order to graduate

students with highly marketable skills. Courses of study can range from specializations in information technology to engineering to energy management to automotive maintenance and repair. An information technology track generally includes the following:

- Network Systems
- Information Support and Services
- Interactive Media
- Programming and Software Development

Today's cars and trucks require 21st century "auto shops" that incorporate specialized programs and computer systems for diagnosing and repairing vehicles.

Drafting and engineering programs have embraced many facets of computer-aided design (CAD), followed by computer-aided manufacturing (CAM) in woodworking and metals.

In the technology-enhanced "machine shop," students use sophisticated computer equipment to design, program, test, evaluate, and collaborate. It is not uncommon to see a room of HVAC equipment within the secondary school environment that is not only managing the climate within the facility, but also serving as a training ground for students interested in pursuing careers in the emerging market of climate control and energy management. Much of the information that these high-tech areas receive from the manufacturers comes to the facility via satellite, regular online updates, or CDs/DVDs.

F. Special Education

The target of special education programming is to provide a diverse array of services to achieve the goals articulated in Individual Education Plans (IEPs) for all students with special needs. Adaptive and assistive technology resources continue to play a significant role in helping to equalize learning environments for students with special needs. Some of the technologies used to assist students in the classroom include, but are not limited to:

- Text-to-speech programs that use a digital voice and read text aloud from software applications, ebooks, or Web-delivered content.
- Word prediction applications that present up to nine different possibilities once the writer begins to type.
- Portable keyboards, alternative keyboards, and switches to simplify the mechanics of the writing process.
- Concept-mapping software that presents information in graphic and outline formats.
- Electronic manipulatives that are digital versions of objects used to demonstrate math concepts (e.g., tangram blocks to create a design or dice to solve a probability problem).

New Jersey and many school districts across the nation are embracing the universal access or universal design model that employs a proactive strategy to embed in the curriculum multiple means to access content, demonstrate

knowledge, and be engaged so that the individual learning needs of all students are addressed. The universal access or universal design model employs the following strategies:

- Proactively installing/activating text-to-speech programs, auditory/visual enhancement, and other assistant applications on instructional computers in each school.
- Securing or scanning all school texts into digital format (national instructional media accessibility standards (nimas) requirements) so that all students can read with text-to-speech assistance, if needed, grade-appropriate textbooks in all disciplines.
- Ensuring that district Web pages adhere to federal accessibility guidelines.
- Providing high-quality, sustained professional development for teachers to help them incorporate universal design for learning principles into their instructional practices.

This overview of the technology-supported learning opportunities and resources available to all students including those in specialized programs, highlights the need for connectivity and technology resources where they might not have been considered before.

G. School- to- Work and Adult Education

New Jersey schools seek to provide superior educational experiences for students who desire to enter the world of work immediately after completing their K-12 education. More and more schools are offering access to training for work-related content for adults in need of retraining in this increasingly digital workplace. The resources planned for students in school-to-work programs can easily be repurposed for adult education courses beyond the hours of the typical school day.

Students of school-to-work and adult education programs are likely to experience the following technology-based environments:

- CAD/CAM design and manufacturing devices.
- Computer-aided automotive diagnosis and repair systems.
- Crisis management and medical emergency simulations for childcare providers and emergency-care first responders.
- Business planning and project management applications.
- Meteorological, atmospheric, environmental and climactic data on the web for agricultural and aquacultural planning.
- Commercial quality print, graphics, photography, and video production resources.
- Business applications associated with the standard office suite of word processing, database, spreadsheet, finance, and accounting.

Career and Technical Education

Career and technical education (CTE) programs have experienced an enormous transformation over the past twenty years from a hands-on curriculum that focused primarily on mechanical, manufacturing, carpentry, housekeeping, childcare and healthcare to a high-technology curriculum that employs technology tools and resources found in real-world business and industry. Career and technical programs offer certification programs in automotive repair, cosmetology, childcare, allied health services, networking, computer repair, technology training, bio-technology, and computer programming. Many of these programs require state-of-the-art facilities outfitted with 21st century tools.

Pre-engineering programs provide courses in the following areas:

- Middle school engineering
- High school engineering
- High school biomedical sciences program

Each of these courses requires specific hardware, software, and facility requirements that should be investigated if considering offering programs such as these.

Adult Education

The 21st century job market, including educational institutions, requires that all adult learners become lifelong learners, able to adapt and change in a global marketplace. No longer is one skill set likely to last an employable lifetime. Public school facilities have an opportunity to garner ongoing support from the greater school community while meeting an important retraining need for adult citizens. Providing access to technology learning environments and course work during primarily non-school hours holds huge potential as a "win-win" situation for preK-12 students and the community alike.

H. Peripheral Devices in Support of Teaching and Learning

Peripheral devices available to students and teachers significantly enhance classroom learning environments. It is expected that most teachers and students will have access to a wide variety of peripheral devices including projection devices, printers, scanners, cameras, CD-ROM and DVD burners, and other devices such as probes, meters, and storage devices. The long-term costs of consumables related to the use of peripherals (e.g., ink cartridges, paper, toner, blank CD/DVDs, USB storage devices, bulbs) are a major factor in selecting and setting standards for peripheral devices. This guide does not set standards for peripheral devices, but rather presents some of the growing collection of peripheral devices available to students and teachers that impact infrastructure planning.

Projection/Display Devices

With respect to projection capacity, many districts are budgeting for permanent large-group display capacity in each instructional area. Sometimes the size of a large television or monitor has not proven sufficient to display complex data or Web-based information. Adequate display capacity may be achieved in the form of a ceiling-mounted projection device, a large flat-panel display in smaller

spaces, or an interactive whiteboard. Over the past five years, projection device prices have dropped significantly, have increased in their brightness and clarity, and are less affected by ambient light conditions. The costs of large flat-panel displays and interactive whiteboards are also decreasing and should be examined regularly. Combination projector/interactive whiteboard units are now available that can significantly cut the overall unit cost due to less supporting infrastructure installation requirements.

Many districts already own portable projection devices and liquid crystal display (LCD) panels. These devices should be deployed regularly to emphasize their potential and to engage teachers in new teaching and learning strategies. If necessary, either of these units can be deployed on a mobile cart.

Document cameras or projectors allow individuals to project three-dimensional items, original print resources, dissection specimens, the screen of a hand-held computer or graphing calculator and any item that can be captured by a camera.

Printers

Schools should look closely at networked printing solutions (e.g., color, black and white, and photo quality) that provide the best return on investment. These solutions include printers capable of accepting an infrared (IR) signal from digital devices, as well as other handheld devices.

Personal Response Systems (PRS)

Personal response systems (PRS) developed for instructional use generally include software and handheld responders used by students to enter responses to teacher-generated questions. These responders transmit individual responses wirelessly back to a computer that instantly tabulates the data and then typically displays a summary of the results for the audience to review.

PRSs can be used for presentation support (general question and answer), surveys, opinion polls, voting, elections, quizzes and tests, group decision-making, and review games. Several different PRS systems are currently on the market for school environments.

Audio Enhancement Systems (AES)

Audio enhancement systems are showing positive results in elementary classrooms for all learners, not just special needs students with auditory deficiencies. The teacher wears an "audio enhancement necklace" which wirelessly relays his/her speech to speakers positioned throughout the classroom. The enhanced audio may help all students focus their attention more closely on the teacher and less on distractions within the everyday classroom environment. Proper acoustical planning in new construction may reduce and/or eliminate the need for audio enhancement systems in many classrooms by increasing the quality of acoustics and lowering peripheral noise levels.

III. Shared Environments

Each school facility has areas that are used and shared by multiple audiences for a wide variety of purposes. These areas may include the library media center, distance learning and video-conferencing facilities, along with video production and distribution studios. The audiences who share these resources consist of students, teachers, administrators, parents, and community businesses/organizations.

The purposes for which these areas are used are expanding each year as the need to research information, learn independently, and reach out creatively increases. Schools seeking to offer an expanded collection of Advanced Placement (AP) courses are using online courses to fill gaps in onsite offerings and meet student demand in a cost efficient manner. Library media centers are expanding their hours beyond the traditional school day and welcoming community members to use research materials, access the Internet, and tap expanded learning opportunities. Local business and community organizations are taking advantage of student expertise and school video distribution resources to reach out to wider audiences.

The following design criteria are referenced in the New Jersey Schools Development Authority's (SDA) *21st Century Schools Design Manual* and have an impact on shared learning environments:

- Design Criteria #3. Visual Comfort
- Design Criteria #12. Accessibility
- Design Criteria #13. Flexibility and Adaptability
- Design Criteria #14. Information Technology
- Design Criteria #23. Community Use

Specific communication, connectivity, projection, production, and acoustical needs for the following shared learning environments are outlined in this section:

A. Information Resource/Library Media Center

B. Distance Learning & Video Conferencing Environments

C. Video Production & Distribution Environments

A. Information Resource/Library Media Center

Located centrally within the school, yet preferably with secure access for community use, the information resource/library media center (IR/LMC) combines the roles of today's library services, audio visual/media departments, and technology centers into one information and technology resource center for teachers and students.

The IR/LMC is defined by its multiple purposes. Given the combined functions of providing access to information, as well as a place to process the information, the IR/LMC offers students and teachers an arena for extensive research and production opportunities. While this configuration is usually not well suited for formal large-group presentations, it serves as a resource-rich facility where independent and small-group learning are encouraged.

Information Resource/Library Media Center Configuration

IR/LMCs need to transform as access to information continues to move toward the digital environment. To support this, the IR/LMC must recognize and provide an environment for high-speed access to the expanding collection of online digital information (print, audio, and visual). In addition to traditional resources provided by the IR/LMC, students and faculty need technology-rich physical environments to collaborate and explore the virtual world. The IR/LMC should create a physical environment for this new world to evolve.

The modern information resource/media centers should be expanded to include the addition of the following areas:

- Virtual Learning Classroom
- Mobile Equipment/Laptop Repair and Information Center
- Teacher, Student Work Rooms and/or Conference Area
- Computer Training Area

In addition, schools should consider the following IR/LMC accommodations:

- Comfortable reading/lounge areas
- Open seating/tables
- Community access via exterior entrance/exit

All computers in this area are connected to the school's network and the Internet.

A sample library media center floor plan drawing is included in Appendix E.

B. Distance Learning/Video Conferencing Environments

The distance-learning classroom is designed to extend learning beyond the perimeters of the school site. This includes both formal and informal learning events. Because it features two-way communication, the range of possible opportunities in which to expand curriculum offerings is virtually limitless. Both staff and students can take advantage of off-site offerings that would otherwise be unavailable to them. With the inclusion of cable TV access, another dimension of learning sources is opened for the educational community. By using video networking capabilities, long-distance conferences can be arranged, participation in national and international forums is possible, and direct access to experts in the field becomes a reality. This form of learning is firmly grounded in communication and mutual networking with others who would otherwise be unavailable as resources.

The growing expectation by students and parents is that schools should provide access to a wide variety of e-Learning options and opportunities, especially free Internet resources. The growing collection of free resources available with high-speed Internet access presents itself as a huge untapped e-Learning resource for students, teachers, parents, and community members.

Distance Learning/Video- Conferencing Configurations

The traditional distance-learning classroom typically consists of a collection of large-screen monitors, video cameras, microphones, speakers, and a telephone/fax that allows "students"- teachers or school-age children - to actively participate, asking and responding to questions, in a class consisting of participants from potentially across the nation or the world.

The multiple monitors and video cameras capture and display participants and activity at the different remote sites. One video camera is generally dedicated to projecting instructor support materials in the form of either computer-generated images, maps, wall charts, close-up hands-on demonstration, such as dissection or hand-written notes. Likewise, microphones and speakers capture and transmit "classroom" oral presentations and discussion. The console to control the flow of voice, video, and data signals within this environment generally requires a custom design specific to each individual location.

Desktop video-conferencing solutions do not require this level of investment, but rather an investment in appropriate computers with cameras, headsets with microphones, and high-speed bandwidth to the desktop.

The distance between remote sites may be within buildings in a single township or among schools across the nation and the world. In the past, the electronic signals sent and received were carried via some combination of satellite, ITFS, fiber optic and coaxial cable requiring a separate network and support structure to support the transmission. Currently, video-conferencing is most typically conducted over the Internet via IP protocols.

Additional information regarding distance-learning and video-conferencing environments is included in Appendix E.

C. Video Production and Distribution Environments

Video production and distribution is evolving as a mainstream activity in education and the environments and systems to support this function continue to expand and become more affordable. Dedicated studio and control room space and equipment are one option, but the proliferation of more powerful computers and video-editing software provide additional options to be considered. Today, every computer on a high-speed network is a potential source of video production, as well as distribution, not only locally but also globally. The challenge is how to manage and control the storage and distribution of this content.

It is not unusual to find live building-level local video broadcasts being produced by students on a regular basis throughout all grade levels. Many schools produce a live morning announcements broadcast distributed to every classroom.

General Guidelines

The space should fit the purpose. If regular video production and distribution is performed, a permanent location should be considered.

1. Production

A. Storage and Network Bandwidth

- Large amounts of digital storage and network bandwidth are required to transfer raw and final production materials for manipulation, editing and ultimately distribution. Anyone engaged in this activity will require multiple gigabytes of file storage. If students are provided network storage, consider options to support this activity and the impact this may have on network storage and bandwidth, particularly if the files will be transferred over the school's wide area network or the Internet.

- Adopt and standardize on one video-editing software package, and install this software on all appropriate computers.

- Set clear guidelines and policy for the storage, backup and retention of raw and final versions of video material. One second of standard uncompressed raw video can consume as much as 25Mb of storage. Final production material should be in a compressed format and align with the standard video distribution methods used by the school.

B. Content Management

- For permanent and more formal video production facilities, the organization and storage of master tapes will require a management and documentation system.

- Consider a publication process that includes cataloging the video media produced with the installed library/media management system.

2. Distribution

Distribution can be performed live and in recorded format:

A. Recorded: Recorded Personal Media, such as tape, DVD, flash drive

- Standardize on one format.

- For tape, assure all digital camcorders use the same tape format.

- For each generation of DVD recording media, set a standard such as DVD+R, Dual Layer DVD+R or Blu-ray.

- Flash drives are generally compatible with most computers with USB interfaces.

3. Network Server

With the proliferation and ease of video production and distribution, where and how video is distributed must be clearly defined from a policy perspective. Network-based video should have clear policy and guidelines about how it will be published and who can view this content. Video content published and made available through a public Web site should be carefully monitored and managed in light of privacy and other important considerations.

Video distribution solutions should be carefully selected and measured against network and other technology infrastructure capacity. Video-streaming solutions exist that can provide the desired result more efficiently with less impact on the infrastructure. Careful selection can result in significant management and maintenance savings.

4. Distribution Network Infrastructure (CCTV)

Installing complete analog Coax-based video distribution networks in new school facilities has been declining as schools select to distribute video over the Category 5e/6a switched Ethernet local area data networks. There are cost savings in eliminating the complexities of installing, balancing and maintaining a separate network for the purpose of video distribution. A digital video distribution system can offer lower cost, as well as increased flexibility, quality and ease of program distribution. The selection of a digital video distribution system must be made early in the planning process and appropriate network outlets will need to be installed where broadcast video is to be displayed or content is to be uploaded to the network.

- Live video production and broadcast versus the distribution of recorded material may require different infrastructure considerations. The program requirements of the facility will drive the infrastructure need. Consider a professional studio if live video production and broadcast is necessary. This type of facility may also consider broadcast capabilities for analog distribution.
- Digital versus analog video production and distribution are vastly different. New schools should implement digital video production and distribution environments taking advantage of the data network. Digital distribution over a converged network that includes voice, video and data offers significant advantages and cost savings.
- The locations where regular live video is to be produced and become a source for rebroadcast over the video distribution network should be identified in the planning stages. These areas should be selected with consideration for lighting, sources of noise (motors, A/C equipment, bells, etc), and access control.

Sample Design Types

Three design prototypes for video production environments are presented for consideration:

- ***Type 1:*** Individual/small-group mobile production. This type of system requires no facility support other than access to facility resources such as electrical power and the network, as needed. Schools should consider creating areas that are better suited for this type of video production, such as small conference rooms where access and noise levels can be better managed. However, these spaces do not need to be designed specifically for this purpose.

- ***Type 2:*** Elementary and middle school studio. These studios are less complex than the professional studio but can still produce high-quality video productions. Depending on the focus of the video production, the size of the room will vary from a single subject to a group production, such as a sports or news anchor type desk. These rooms may function as dual purpose rooms and could potentially be integrated with a distance learning classroom.

- ***Type 3:*** High School/Vocational School Professional Studio. This permanent installation will require significant design planning to accomplish. These spaces are intended primarily for intensive and professional video production. Significant planning and support is necessary to sustain a professional studio that is used regularly. Careful attention to how video is managed and transmitted to the school, district and other networks will be necessary to assure smooth operations. Equipment and interface specifications in this design will dictate facilities design.

Additional information regarding video production and distribution environments is included in Appendix E.

IV. Large Group Environments

With the ever-rising cost of energy and the limited availability of space, districts are seeking ways to maximize the use of space for large-group environments. The auditorium that sits unused for much of the week is a luxury that few can afford in times when classroom space is at a premium. Additionally, areas that can accommodate large groups enhance opportunities for schools to extend learning and community access and participation beyond the school day. By designing large-group environments that meet the diverse needs of the school and community, schools can become the focal point of the community, thus increasing parents' and community members' participation in their students' education and their overall support of the school.

To ensure the security of the less public areas of the building, large-group environments should have exterior entrances and be partitioned off from classrooms and offices.

The following design criteria are referenced in the New Jersey Schools Development Authority's (SDA) *21st Century Schools Design Manual* and have an impact on large-group environments within school facilities:

- Design Criteria #3. Visual Comfort
- Design Criteria #12. Accessibility
- Design Criteria #13. Flexibility and Adaptability
- Design Criteria #14. Information Technology
- Design Criteria #23. Community Use

The following recommendations from the *Best Practices Standards for Schools Under Construction or Being Planned for Instruction* impact large-group environments:

- Video surveillance cameras shall be installed throughout the exterior and interior of the building, covering areas shall include, but not limited to, infrequently occupied areas that are not locked or alarmed such as, but not limited to, auditoriums.

Specific communication, connectivity, projection, production, and acoustical needs for the following large-group school facilities are outlined in this section:

A. Auditorium/Theater

B. Cafetorium/Multipurpose Area

C. Gymnasium/Athletic Fields

A. Auditorium/Theater

The auditorium/theater area can be used for a number of events that involve a large audience: dramatic and musical performances, speakers, film presentations, assemblies, dance recitals, and town meetings, to name a few. These events require a setting that is handicapped-accessible (including ADA listening device capability), well-ventilated, and acoustically sound.

Ideally, the auditorium has a separate exterior entrance near the stage to facilitate the loading of props and other equipment, as well as an exterior entrance for the audience. These will also serve as egresses in case of an

emergency. If this area is to be used by the community, there should be a means of partitioning it off from classroom and office areas.

The auditorium/stage area represents a presentation area for the entire school. The ability to present information to a large group is particularly important and, therefore, requires technology tools, such as video projection systems and large-screen displays. The fixed mounting of these devices normally is recommended because of the set-up time required. If these devices are planned and the locations are identified, both data and video cabling can be arranged. Usually it is recommended that multiple video cable drops be located throughout the auditorium to provide for videotaping or live broadcast of events. Likewise, a Codec video-conferencing system in this area may be considered.

It is recommended that the main room of the auditorium/theater area include the following equipment:

- Telephone
- Cable port for viewing and broadcast
- Data ports throughout areas
- Wireless access points
- Video projector on mobile stand/fixed position (mounted in rear projection booth)
- Large, electric front screen
- Modulated lighting
- Stage lighting
- Acoustical design
- Control panel for lighting, sound, and screen

Recommendations for the projection, sound, and video-recording areas include the following equipment:

- Stage lighting control panel
- Stage sound control panel
- Large area projector
- Video recording studio and equipment
- Data ports
- Cable broadcast hookup
- Security cameras (if needed)

Recommendations for the back stage area include the following equipment:

- Stage lighting
- Control panel for curtains
- Telephone and phone line
- Data ports

Sample floorplan drawings for typical auditorium/theater, sound/projection/video production area, and backstage area are included in Appendix E.

B. Cafetorium/Multipurpose Area

To maximize the use of space in newly constructed and renovated school buildings, many schools have one or more rooms that serve multiple purposes. The cafetorium is popular because it combines the features of an auditorium with the traditional food service requirements, enabling the space to be used for performances, large-group presentations, and meetings and eliminates the need for a less frequently used auditorium. The space should be adaptable and configurable for other school needs such as standardized testing.

These various uses require a setting that is handicapped-accessible, well-ventilated, and acoustically sound. The cafetorium should have a separate exterior entrance near the kitchen to facilitate the loading of supplies. An exterior entrance for the students and community members will also serve as an egress in the event of an emergency. Since the community also uses this area, there should be a means of partitioning it off from classroom and office areas.

The cafetorium should have video projection systems, large-screen displays, and a local sound system. Fixed mounting of these devices is normally recommended because of the set-up time required. Usually it is recommended that video cable drops be located in the cafetorium to provide videotaping or live broadcast of events and to enable the room to accommodate overflow for broadcast of events such as graduations. The cafetorium may also require data drops for point-of-sale terminals, card readers, and reverse-ATM machines through which students can deposit funds in lunch accounts. Wireless access should be considered throughout in order to give the space the flexibility for activities, such as online testing.

The following equipment should be considered for food service, preparation and serving areas:

- Networked point-of-sale (POS) terminal per food service line
- Telephone
- High-quality printer

The following equipment should be considered for food service offices:

- Networked computer for director and clerical support staff
- Integrated fax
- Telephone
- High-quality printer

The following equipment should be considered for student dining/common areas:

- Flat panel displays that can be used for electronic bulletin boards, CATV broadcast and in room presentations
- Cable TV drop

- Data ports throughout
- Wireless access points
- Video projector on mobile stand/fixed position
- Projection screen
- Telephone cable drop
- Acoustic treatment
- Light track
- Audio system
- Security cameras (if needed)

Sample floorplan drawings for typical cafetorium are included in Appendix E.

C. Gymnasium/Athletic Fields

Athletic events continue to provide communities with opportunities to engage in healthy competition in a manner that supports school districts and promotes community spirit. For this reason, a state-of-the-art gymnasium and athletic facility is desirable. A school athletic facility can also provide an arena for students, teachers, administrators, and community members to adopt/enjoy healthy lifestyles.

An arrangement for data and video drop cabling in the gymnasium, on the athletic fields, track facilities, stadiums, and other sports-related areas is recommended to support the ability to videotape or provide live broadcasting of events held in these areas. Planning for multiple video drops provides greater options for camera angle coverage.

The following equipment should be considered for gymnasiums:

- Data/video ports and monitors that can be used for video displays of electronic bulletin boards
- Video projector on mobile stand, video monitor on mobile stand, large electric front screen
- Video camera origination points
- Electronic scoreboard
- Telephone
- Wireless access points
- Security cameras (if needed)

The following equipment should be considered for athletic offices:

- Networked computer per teacher per office site
- Integrated fax/printer/scanner
- Telephone

- Data drops

The following equipment should be considered for weight rooms:

- Telephone
- Wireless access points
- Data drops
- Audiovisual/display capability

The following equipment should be considered for athletic fields:

- Large electronic scoreboard
- High-quality sound system
- Exterior lighting system
- Control panel for sound and lighting control
- Broadcast booth for announcer
- Video broadcast capability
- Connection for projector, when needed
- Electric panel for projection
- Data/video drop
- Electronic timing equipment
- Security cameras (if needed)

Sample floor plan drawings of typical physical education areas are included in Appendix E.