Introduction to Assistive Technology

Many students with disabilities require assistive technology to participate in and benefit from their educational programs. A range of technology solutions is available to support student performance, achievement, and independence in the following areas: academics and learning aids, aids to daily living, assistive listening and environmental aids for the hearing impaired and deaf, augmentative communication, computer access, leisure and recreation, seating, positioning, mobility, and vision. Students who have access to the appropriate assistive technology solutions that they need are more likely to be successful in their educational programs.

The purpose of this document is to provide introductory information on the types of assistive technology solutions that are available for student use. An updated vendor list is included to provide information on commercial sources for obtaining the assistive technology solutions referenced in this chapter. Inclusion in the assistive technology vendor list does not indicate endorsement of the product or the vendor by the Georgia Project for Assistive Technology. Additional resources on assistive technology are available in this manual in the following documents: Assistive Technology Consideration Guide and Internet Resources in Special Education documents.

Technology Areas

Academic and Learning Aids:

Many students with disabilities use assistive technology to enhance their participation and achievement in their educational programs. There are a range of assistive technology solutions to address student needs in all academic areas including writing, spelling, reading, and math. In the following section, information will be provided on assistive technology that is frequently used within each of these academic areas.

Reading: Students who demonstrate difficulty with basic reading skills or reading comprehension skills may benefit from assistive technology. The following is a brief listing of the types of assistive technology solutions that are available to support reading skills:

> **Colored overlays:** These acetate overlays alter the contrast between the text and the background paper on which the text is printed. For some students who have difficulty with reading due to visual perceptual difficulties, this low technology modification enhances their ability to decode the words displayed on the page. Colored overlays can be constructed from colored acetate report covers or purchased from See It Right and Crystal Books.

> **Reading window:** This low technology solution is beneficial to students who have difficulty tracking the lines of print displayed on a page. Reading windows are typically constructed of cardboard or heavy stock paper. A "frame" the size of a standard line of text is cut in the cardboard. The student then moves the reading window down the lines of text, one line at a time, highlight the current row of text.

> **Hand-held spell checker or talking dictionary:** These easy to use, low cost assistive technology solutions provide support for students who have difficulty decoding the words presented on the page. Students type in difficult to read words on the device and the typed in word is spoken aloud by the device. This type of technology is appropriate for students who can read the majority of the words in a reading sample. Students with

more significant difficulty may require a more sophisticated reading solution. Franklin Educational Systems offers several models of spell checkers and dictionaries.

Audio-taped textbooks: Some students who have difficulty reading traditional print textbooks and related instructional materials may benefit from using audio-taped text to supplement the printed materials. Ideally, students should follow along in the text as the text is read aloud through the tape player. Textbooks on tape are available to students with disabilities through the Recordings for the Blind and Dyslexic.

Talking word processing program: Students who benefit from auditory text may also benefit from the use of a computer-based talking word processing program. These low cost software applications provide speech output of text displayed on the monitor. Printed text may be read aloud, word by word, sentence by sentence, or paragraph by paragraph. Text may also be visually highlighted as the words are read aloud. Any text entered into the application can be read aloud. For example, a test or worksheet created by the teacher can be read aloud to the student. Moreover, text can be imported into the talking word processor from other sources such as disks, the Internet, and other software applications. Two frequently used talking word processing programs include IntelliTalk II (IntelliTools) and Write OutLoud (Don Johnston).

Advanced reading aid: Some students require more sophisticated reading solutions. These advanced reading aids including WYNN (Arkenstone) and Kurzweil 3000 (Lernout and Haupsie) offer speech feedback like the talking word processors referenced above. In addition, they offer talking definitions of unfamiliar words and other advanced reading features.

Spelling: Students who have difficulty with spelling can benefit from assistive technology to identify and correct their spelling errors. Technology is available to support spelling in hand-written as well as computer generated text. The following is a brief listing of several types of assistive technology solutions to support spelling skills:

Personal word list or dictionary: This low technology solution is appropriate for students who tend to have on-going difficulty misspelling the same words. Frequently misspelled words are written in alphabetical order in a word list or in a dictionary. This option is appropriate for students who can recognize the correctly spelled word in the word list. This option will not be beneficial for students who have difficulty recognizing the correct spelling of the misspelled word in print.

Hand-held spell checker: There are numerous models of these hand-held devices that assist students in correcting misspelled words in handwritten communication. With these devices, students type in the word that they are having difficulty spelling. Then a list of correctly spelled words that most closely approximate the misspelled word are displayed in a correction list on the screen. On the models that do not offer speech feedback, the student must look down the list of words until the he sees the correct spelling of the word. These models require that the student be able to visually check the words in the correction list to identify the correct word. Other models offer speech feedback of the words in the correction list and are appropriate for students who have difficulty visually locating the correctly spelled word in the correction list. In order for hand-held spell checkers to be effective tools, students must be able to identify errors within their writing samples and then use the device to correct the misspelled words. Hand-held spell checkers are available at most office supply stores and are available from Franklin Educational Systems.

Standard word processing program with built-in spell check: The computer affords students with spelling difficulties an invaluable tool for identifying spelling errors. In most commercially available word processors such as Microsoft Word, misspelled words are

underlined immediately after the word has been typed in. Students may choose to stop typing and correct the word or may complete the document and then do a spell-check at the end. When using the spell check features of standard word processors, a correction list is presented for each misspelled word. Students must look down the list to identify and select the correctly spelled word. This requires that the student be able to visually identify the correct spelling of the word.

Talking word processing program with built-in spell check: These computer-based programs are appropriate for students who can not visually identify the correctly spelled word in the correction list referenced above. Talking word processing programs offer speech feedback of all the words in the correction list. This allows the student to "listen for" the correctly spelled word. Once the desired word is heard and selected by the student, the correct spelling is entered into the document. Popular talking word processing programs include IntelliTalk II (IntelliTools) and Write OutLoud (Don Johnston).

Writing: Students who have difficulty producing written communication with standard writing tools such as pen and paper may benefit from assistive technology. There are a range of solutions available including those listed below:

Alternative paper: For students who have difficulty writing due to fine motor impairments, it may be appropriate to modify the surface that the student is writing on. One solution would be to use paper that has bold lines. Another solution would be to use tactile paper. This paper presents a raised line that provides students with a tactile baseline for writing letters on. Graph paper may also be used to support improved legibility of handwriting. Students are taught to put one letter in each box resulting in more evenly spaced letters and words. Graph paper may also be enlarged on the photocopier to provide a larger area to write in. The types of alternative paper are available from school supply stores and from companies such as LS&S. Writing guides for various types of paper are available from Independent Living Aids.

Pencil grips: Some students who have difficulty writing due to fine motor impairments may benefit from the use of a pencil grip. This inexpensive writing solution attaches to a standard pencil and gives the student a larger and more supported means of holding a pencil. They are available from most school supply stores and from companies like Sammons Preston.

Adapted tape recorder: This type of technology solution may be used in several ways to support writing skills. Students who have difficulty writing, but who have good speech skills, can dictate information orally and have it recorded on the tape. This can then be turned in as an alternative to a written product. Adapted-tape recorders can also be used to record lectures in classes for students who have difficulty with note taking. These tape recorders have a special feature known as an indexer that make them particularly useful. The index feature allows the student to mark key points on a tape. Then, when the student listens to the tape at a later time, they can fast forward to the location on the tape without having to listen to all of the pre-recorded information. Adapted tape recorders are available from the American Printing House for the Blind and LS&S.

Portable word processor: Students with more significant writing difficulties often require and alternative to pencil and paper. For many students, portable word processors such as the AlphaSmart (AlphaSmart) offer a viable alternative to more expensive computer-based writing solutions. These devices permit students to type in text using a full-sized keyboard. The text that is typed in is displayed on a small LCD screen. Text can also be stored in files and retrieved for future use. Text may also be uploaded into a computer-based word processing program and edited and stored as

needed. Text from the computer-based word processing program can also be downloaded to the portable word processor. Most of these devices allow for direct printing from the device. In addition, a built-in spell check is included to assist students in editing their writing.

Talking word processor software: Many students who exhibit difficulty editing their computer-based writing can benefit from the use of a talking word processing program. This program contains a speech feedback feature that speaks letters, words, sentences, and entire paragraphs aloud as they are typed in by the student. The type of feedback that is provided is set in the speech menu of the program. This multisensory feedback assists students in identifying and correcting grammar and spelling errors. The programs also contain a talking spell check that is beneficial to many students. Popular talking word processing programs include Write OutLoud (Don Johnston) and IntelliTalk II (IntelliTools).

Word prediction software: This type of software is beneficial for students who have difficulty with spelling and grammar. As students type in the first letter or letters of the words, the computer predicts the word that the student is trying to type. Words appear in a prediction list and students select their desired words from this list. Words may be selected through visually identifying the desired word from the list or through listening to the words in the prediction list to select the desired word. Another benefit to this type of technology for students with slow typing is that it reduces the number of keystrokes that a student has to type in. Popular word prediction programs such as Co:Writer (Don Johnston) are available across computer platforms.

Outlining and webbing software: For students who have difficulty brainstorming and organizing their thoughts during the pre-writing phase, this type of technology may provide them with the organizational support that they need to produce a better written product. The technology may be used by a teacher as a part of a pre-writing activity or by an individual student. Webbing programs allow the student to create a graphic diagram of the key points that will need to be covered during the writing process. The visual display offers an appropriate medium for assisting the student in organizing his thoughts. The diagram based web can also be transformed into a text outline. This outline can then be copied into a standard or talking word processing program as a guide for actually composing the written product. A popular webbing program is Inspiration (Inspiration Software).

Voice dictation software: Students who have difficulty with handwriting or computer-based writing using the standard computer keyboard, may benefit from using voice dictation software. With this type of technology, the student speaks the text into a microphone attached to the computer. The speech is then translated by the on-board speech processor and converted into text that is displayed on the computer's monitor. Text may also be edited using speech commands. Generally, students who use voice dictation software must do so in a quiet environment due to interference from other speakers in the classroom. It may also be disruptive for a student using voice dictation software to dictate in the classroom. However, for some students this type of technology may be the most appropriate means of producing writing. Popular voice dictation software includes Dragon Naturally Speaking (Lernout &Hauspie) and Via Voice (IBM).

Math: Assistive technology is also available to support student achievement in the area of math. A range of low technology to high technology solutions are available including:

Calculators: Students who have difficulty with math calculations can benefit from the use of a calculator. Various models are available including desk top and hand-held calculators. These standard models typically have smaller buttons and a small LCD for

displaying the numbers entered. Some students need adapted calculators. For example, students with physical disabilities may need a calculator with large buttons. Students with visual impairments may need a device with large buttons and a larger display so that the students can see the numbers displayed. Talking calculators are also available for students who need or benefit from the speech feedback feature.

On-screen electronic worksheet: Some students have difficulty completing math problems due to difficulty in writing out the problems. One solution may be to have the problems displayed on the computer monitor and to have the students complete the programs by typing in responses on the computer. One method of obtaining an on-screen worksheet is to use a scanner with an Optical Character Recognition program to scan in worksheets that are already available. The student then types in his answers on the computer and prints out the worksheet when finished. Another solution for obtaining on-screen worksheets is to use a commercially available program such as MathPad (IntelliTools). Worksheets may be generated from a previously created problem list or through entering new problems. The worksheet is then displayed on the screen for the student's use.

Organizational and Study Skills: Some students with disabilities have difficulty with organizational skills. This makes it difficult to complete tasks and assignments in a timely manner. Assistive technology may also be used to support organizations skills.

Assignment book: This modification is beneficial to many students. It provides them with a means of recording class assignments and key points to remember. Many schools require students to keep assignment books.

Computer-based organizational software: Programs are also commercially available for the computer to assist students in organizing their assignments. A file within a word processing document can also be used for this purpose.

Aids to Daily Living: An array of low technology to high technology aids are available for students who have difficulty independently completing activities of daily living. Daily living aids include aids for tooth brushing, eating, drinking, dressing, toileting, and home maintenance and they are typically used by students with physical disabilities. The following are categories of frequently used daily living aids:

Adapted eating utensils: Low technology aids are available to assist students with feeding themselves. Eating utensils such as spoons, forks, and knives often present a challenge to students with physical disabilities who have difficulty grasping a standard utensil. Adaptive utensils include spoons, forks, and knives with "built-up" or enlarged handles and cuffs for holding utensils. Electronic eating aids are also available for individuals with more severe physical disabilities. Adapted eating utensils are available from Sammons Preston.

Adapted drinking aids: Students who have difficulty holding and drinking from a standard cup or glass may benefit from an adapted drinking aid. Frequently used aids include adaptive handles for cups and glasses, positioning aids for stabilizing the cup or glass on the table or wheelchair tray, and cups and glasses with modified rims to prevent excessive spillage. Adapted drinking aids are available Sammons Preston.

Home maintenance: Some students may require access to daily living aids that enable them to complete tasks related to food preparation. For example, adapted measuring and pouring devices are available for those students who have difficulty using standard measuring and pouring devices. Home maintenance aids are available from Sammons Preston.

Self-care aids: Students may also need assistive technology to support their ability to complete self-care tasks such as dressing, grooming, and toileting. Frequently used dressing aids include adapted sock aids for putting on and taking off socks, zipper grips for pulling up and down zippers, and button hooks for buttoning and unbuttoning buttons. Grooming aids include brushes and combs with adaptive handles, adaptive bathing aids, and toothbrushes with adaptive handles. Toileting aids include adapted toilet seats and other related aids. Self-care aids are available from Sammons-Preston.

Assistive Listening Devices and Environmental Aids for the Hard of Hearing and Deaf:
Students who are hard of hearing or deaf often need assistive technology to access information that is typically presented verbally and accessed through the auditory modality. A variety of technology solutions are available that amplify speech and other auditory signals or that provide an alternative to the auditory modality. These include:

Assistive Listening Devices: These devices amplify sound and speech to enable a student who is hard of hearing to hear better in various listening environments such as the classroom, other school environments, the community, and the home. These devices "improve the signal to noise ratio" by amplifying the desired sounds and minimizing the undesirable sounds. For example, in the classroom setting, the teacher's voice may be amplified and the ambient noise in the classroom would be minimized. Assistive listening devices may also be used to enhance listening and enjoyment of television and music. Personal amplification systems are portable and can be used across different environments. These systems consist of a transmitter that transmits the sound source to the student's receiving unit that includes headphones, earphones, or neck loops. Sound field amplification systems are also available. Personal sound field systems consist of the transmitting source and a receiving unit paired with a portable speaker. Sound field systems are also available for entire rooms. With these systems, the speakers are typically mounted onto the ceiling or walls of the room. Assistive listening devices are available from Phonic Ear, Harris Communication, and Audio Enhancements.

Text Telephones (TTY): These easy-to-use technology solutions enable students who are hard of hearing or deaf to communicate over the telephone by typing in messages using the TTY keyboard. The message is then transmitted to the person that the student is calling and the message is displayed on the screen of the receiving TTY. The student caller and the other party then communicate with each other by "typing messages" back and forth. Some TTYs have answering machines built-in and some models offer a print-out of the text received. TTYs may be pocket-sized and portable or larger to sit on a desktop. Various models of TTYs are available from Harris Communications.

Closed Captioning Devices: Modern televisions are equipped with built-in captioning decoders that allow for the presentation of a visual text display on the television screen that corresponds to the speech in the television program or movie. This works with programs and movies which have been captioned by the manufacturer or producing agency.

Environmental Aids: Environmental aids include adapted clocks and wake up systems, notification systems, pagers, and warning devices-detectors. Adapted clocks offer different options that provide an enhancement or alternative to the traditional "buzz" including an adjustable buzzer volume, a flashing light, or a bed vibrator. Visual alert signalers are available to alert the student to the telephone ringing, the doorbell ringing, the fire alarm or smoke detector, and the weather alert warning system. Personal pagers are also available with vibrating receiver and text messaging are also available. A variety of environmental aids are available from Harris Communications.

Real Time Captioning: Technology is currently available to caption speech such as class lectures and presentations to offer immediate text display. This requires a computer with required software and a projection system to project the text for student viewing.

Augmentative Communication:

Students with severe expressive communication impairments have difficulty communicating with peers and adults within their environments. Many of these students need a means of supplementing their communication skills. These students frequently use augmentative communication technology. A range of low technology to high technology solutions are available including:

Object-based communication displays: These low technology solutions use object symbols to represent messages within daily activities. Objects representing certain events and activities are attached to a board. The student selects or touches the object to indicate his wants and needs. Object-based communication displays are typically developed for students with severe intellectual disabilities and students with severe visual impairments who are nonverbal.

Picture communication boards and books: These low technology augmentative communication solutions contain pictures to represent frequently communicated messages. The pictures are organized on various pages or displays typically around certain activities of the student's day. For example, the book may contain a page for calendar, snack, leisure, academics, etc.. The pages are changed as the activities change to provide access to appropriate vocabulary.

Alphabet boards: Students who are able to generate new messages through spelling can use an alphabet board. Letters of the alphabet are printed on the board, typically in the same order as a computer keyboard. Students touch the individual letters in sequence to build words, phrases, and sentences. This communication solution provides the student with a means of communicating messages that may not have been available on a picture board.

Talking switches: Recent advances in assistive technology have provided beginning communicators with low technology augmentative communication solutions that offer speech output. Talking switches typically allow for pre-recording of one or two messages per activity. Messages are spoken aloud when the student activates (presses on) the top of the switch. Picture symbols or object symbols may be attached to the top of the switch to represent the message. It is necessary to change the messages between activities to provide access to appropriate vocabulary. Popular talking switches include the BigMack (Ablenet), which offers access to one pre-recorded message, and the Twin Talker (Enabling Devices), a device that allows for recording and access of up to two messages per activity.

Low technology voice output communication devices: A range of low technology solutions are available to students who need access to a larger vocabulary set. Typically, multiple messages can be recorded on these devices. For example, up to four messages can be recorded on the Cheap Talk 4 (Enabling Devices) and the Tech Talk 4 (Mayer Johnson). Up to eight messages can be recorded on the Cheap Talk 8 (Enabling Devices) and the Tech Talk 8 (Mayer Johnson). Messages are pre-recorded by an adult or peer and accessed by the student by selecting the appropriate location on the device's display. Messages may be represented by picture symbols. On the before-mentioned single display communication devices, the displays have to be changed as the activities change and new messages have to be recorded. Some devices provide for recording and access of messages on multiple communication displays. For example, the Six

Level Communicator (Enabling Devices) allows for recording of up to eight messages on each of the six communication displays. With this device, students have access to up to forty-eight messages. On the Tech Talk 8 x 8 (Mayer Johnson), up to eight different messages can be recorded and accessed on each of the eight communication displays resulting in a potential total of sixty-four messages.

Middle technology voice output communication devices: These augmentative communication solutions provide access to a larger number of messages on multiple communication displays or levels. Messages tend to be represented by picture symbols. The are pre-recorded by an adult or peer and are accessed by the student by activating the corresponding location on the communication display. Some models offer alternative access techniques such as microswitch access for those students who do not possess the fine motor skills to touch the areas on the communication display. Middle technology voice output communication devices include the TechSpeak (Mayer Johnson), the MaCaw (Zygo Industries), and the AlphaTalker (Prentke Romich Company).

High technology voice output communication devices: Students who need access to a large vocabulary may need a high technology voice output communication device. These devices typically provide access to a large number of messages on multiple overlays. An example of a high technology device is the Liberator (Prentke Romich). Some devices offer paper-based displays while others offer dynamic displays. These dynamic display communication devices have computer-like displays on which the symbols are displayed. Pages are changed by selecting a pre-programmed location on the display. This feature allows for rapid access to messages. Several dynamic display communication devices including the DynaVox and DynaMyte are available from DynaVox Systems. Some of the high technology devices offer access to text-to-speech. This feature allows students to type out messages on an alphabet display.

Integrated communication solutions: During the past years, several software-based applications have been developed that enable students to use a notebook computer as an augmentative communication device. Most of the solutions provide access to picture-based communication displays as well as an alphabet display for text to speech generation of novel messages. Examples of integrated augmentative communication solutions include Speaking Dynamically (Mayer Johnson) and DynaVox software (DynaVox Systems).

<u>**Computer Access and Instruction:**</u> A variety of technology solutions are available to adapt the classroom computer for students with disabilities. Some computer access technology offers a method of input other than the standard computer keyboard and mouse. Other computer adaptations include software and hardware that modifies the visual and sound output from the computer. The following is a summary of several types of adaptive computer technology:

Adaptive pointing devices: Several low technology devices such as hand-held pointers, hand splints, and mouth sticks are beneficial for students who have difficulty accessing the individual keys on the computer keyboard using their hands. These devices provide a smaller surface for accessing the keys. Various models of the adaptive pointing devices referenced above are available from Sammons Preston.

Keyboard adaptations: The computer keyboard can also be adapted to enhance access for students who have difficulty accessing the keys on the computer keyboard. A popular solution is a keyguard that is a Plexiglas cover for the keyboard with the areas corresponding to the keys on the keyboard cut out. When using a keyguard, the student must get his or her finger or one of the adaptive pointing devices referenced above into the cut out to access the keys. Keyguards are available from Sammons Preston and Don Johnston.

Alternative keyboards: Another type of assistive technology that is used to enhance computer access for students with disabilities is an alternative keyboard. Typically, these keyboards can be divided into two categories: enlarged keyboards and mini-keyboards. Enlarged keyboards are larger than the standard computer keyboard and offer enlarged touch surfaces for each of the keys on the keyboard. Several models of enlarged keyboards including the IntelliKeys (IntelliTools) can be customized to meet the student's needs and activities. Enlarged keyboards are generally appropriate for students who need an enlarged area for key activations due to physical or visual needs. Students with physical disabilities who have a decreased range of motion (ability to reach very far) can benefit from a smaller keyboard known as a mini-keyboard. These keyboards are smaller than the standard computer keyboard, often have smaller keys than the standard keyboard, and require less range of motion. Popular mini-keyboards include the TASH Mini (TASH) and the Footprint keyboard (Dartek).

Touchsreens: Touchscreens are pressure sensitive screens that are attached to the monitor of the computer. Students using a touchscreen actually touch the touchscreen on the desired location. Movement of the student's finger on the screen guides the mouse movements and tapping the touchscreen serves as the mouse click. Touchscreens are particularly appropriate for young children who have difficulty transferring their eyegaze between the computer monitor and the keyboard. Touchscreens are available from KeyTec.

On-screen keyboards: This software application provides an on-screen representation of the keyboard on the computer monitor. Students select letters on the keyboard with a Mouse, mouse alternative, or single switch through scanning. Keyboards may be customized for individual student use. A popular on-screen keyboard is the Discover Screen from Don Johnston.

Microswitch access: Students with significant physical disabilities can access appropriate software applications through a microswitch and a switch interface box. Microswitches work with software written specifically for switch use and can be used with software that is not designed for switch use through an on-screen keyboard. Micorswitch interface boxes are available from Don Johnston and TASH.

Mouse alternatives: For students who have difficulty controlling the standard computer mouse, a variety of mouse alternatives are available. They include trackballs, joysticks, and trackpads. Mouse alternatives are available from Don Johnston and local computer supply stores.

Voice input technology devices: New developments in voice input technology in recent years have made it a viable alternative for computer input. The student speaks the text or commands into a microphone. The speech is received and processed by the computer and translated into printed text which is displayed on the computer screen. Students must review the text and make any required corrections to maintain the integrity of the voice file. Frequently used voice input programs include Dragon Naturally Speaking (Lernout and Haupsie) and Via Voice (IBM).

Adaptive output: The computer's output can also be adapted for students with visual impairments. Text and graphics displayed on the screen can be enlarged through a screen enlargement application such as ZoomText (AI Squared). Text displayed on the screen can also be read aloud to the student using a screen reading application such as JAWS (Henter Joyce). The printed output can also be modified for student who cannot read standard print. Text can be enlarged or printed out in braille through the use of a braille embosser.

Environmental Aids: High technology environmental aids are available to assist students with physical disabilities in controlling electronic appliances within the school and home. These devices allow the student to use an alternate input device such as a microswitch to control one or more electronic appliances such as lights, televisions, and electronically controlled doors.

Mobility Aids: Students with physical disabilities often need access to mobility aids to provide them with a means of moving about their environments. Mobility aids include canes, crutches, walkers, scooters, and wheelchairs. Generally, assistive technology devices such as the mobility aids referenced above are recommended by physical and occupational therapists based on the student's individual needs.

Pre-vocational and Vocational Aids: Students with physical and cognitive disabilities who are enrolled in educational programs that address pre-vocational and vocational skills may benefit from the use of pre-vocational and vocational aids. These types of technology solutions include modifications of the tools and manipulatives used in the completion of work related tasks. Low technology solutions include grips for handling materials and stabilization devices for supporting work materials. For students using electronic appliances such as staplers and paper shredders, an environmental control unit such as the model available from Ablenet can be used to allow for microswitch control of the appliance. Many of the adaptations required for participation in work activities may be teacher constructed. For example, a picture-based task schedule can be created to represent all of the steps in a particular activity for students with intellectual disabilities.

Recreation and Leisure: Some students with physical, sensory, and intellectual disabilities require assistive technology in order to participate more fully in appropriate recreation and leisure activities. A range of low technology to high technology solutions are available including game adaptations, book adaptations, switch adapted toys, and environmental control access for televisions, videos, tape players, and CD ROM players. Examples of these technology solutions include:

>**Game and puzzle adaptations:** Games and puzzles may be adapted by adding knobs to the component pieces, by using card holders, and by using grabbing devices to pick up game and puzzle pieces. Many of these adaptations are made by teachers and therapists working with the student while other adaptations are commercially available from Sammons Preston.

>**Book adaptations:** Frequent adaptations include enlarging the size of text and graphics for visual access, adding "page fluffers" to create an enlarged space between the pages of the book, and adding picture or tactile symbols for non-readers.

>**Switch adapted toys:** Battery operated toys may be adapted for students who are unable to operate them using the standard operational features. For example, battery operated toys can be operated via a microswitch through a battery interrupterr. Adapted toys are available commercially through vendors such as Enabling Devices. Toys may also be adapted for switch access using switch interrupters available from Ablenet and Enabling Devices.

>**Environment control units:** These low technology devices afford students with physical disabilities with a means of operating electronic appliances such as televisions, radios, and CD players through the use of a single switch. Typically, these types of environmental control systems allow the student to turn the appliance on and off but do not allow for more advanced operations. Ablenet makes a power control unit that is inexpensive and easy-to-use.

Seating and Positioning: Students with physical disabilities often require adaptive seating and positioning systems as an alternative to the standard classroom seating systems. Adaptive seating and positioning systems include seat inserts for wheelchairs, side liers, prone standers, and adaptive chairs. These seating and positioning systems are generally determined by the physical and occupational therapist in consultation with the classroom staff. Sammons Preston offers several different seating and positioning devices for the classroom.

Visual Aids: Students with visual impairments can benefit from assistive technology in a variety of areas. A critical need for assistive technology is often in the area of accessing printed information and to providing a means of producing written communication. This section includes information on frequently used visual aids and related technology solutions:

> **Talking dictionary:** This hand-held technology solution provides students with speech feedback of the words typed in. The devices also read definitions aloud to the student. An earphone can be used in the classroom to prevent interruptions to other students. A Popular model is the Language Master Special Edition from Franklin.

> **Adapted tape player-recorder:** An adapted tape recorder is frequently used to access pre-recorded information such as Books on Tape, audio-taped textbooks from the Recordings for the Blind and Dyslexic and leisure reading materials provided through the Regional library system by the Library of Congress. This type of technology may also be useful in recording notes in class and playing them back later for review.. Students may also dictate and record text on the recorder as an alternative to writing. The Handicassette from the American Printing House for the Blind is a popular model.

> **Large print and talking calculators:** Students who are not able to see the text displayed on the display of a standard calculator may benefit from a large print calculator or a talking calculator. The large print model contains a enlarged buttons on the calculator keypad and a larger display for viewing the numbers. Students who have more significant visual impairments or who are blind may benefit from a talking calculator. Number typed in and information displayed in the LCD are read aloud to the student. Large print and talking calculators are available from LS&S. A talking scientific calculator is available from the American Printing House for the Blind.

> **Braille writer:** A portable writing device for producing braille. Students type in text on the keyboard using the six key entry method. Braille is then embossed on the paper Inserted into the Braillewriter. Braille writers are available from Howe Press.

> **Electronic braille writers:** Several manufacturers make electronic braille writers that are lightweight and offer an alternative to more traditional braille writing devices. Students enter information using the six key entry method of input. Information entered is read aloud to the student. Information entered into the device can be printed using a braille embosser or uploaded to a computer for editing and storage. A popular electronic braille writing device is the Braille N Speak from Blazie Engineering.

> **Closed circuit televisions (CCTV):** This technology solution is appropriate for students who benefit from enlargement of text and graphics. A page of paper containing text is placed on the base under the camera. The image of the page is then displayed on the monitor of the CCTV at the level of magnification selected. The foreground and background colors can be modified for optimum viewing. CCTVs are available from Telesensory,

> **Text enlargement software:** Software is also available to increase the size of text and graphics displayed on the computer monitor. Most screen enlargement applications

allow the student or teacher to control the level of magnification and to alter the foreground background contrast. Frequently used text enlargement applications include ZoomText (Ai Squared) and LP Windows (   ).

Screen reading software: Students with visual impairments and blindness may also benefit from screen reading applications. These technology applications enable the computer to read aloud all text displayed on the monitor including text in the menus. A popular screen reading application is JAWS (Henter Joyce).

The preceding section provides introductory information on the range of assistive technology solutions that are available to support access to the school curriculum and student achievement for students with disabilities. This listing of devices is not comprehensive. For an extensive database of assistive technology solutions across technology areas, the reader is referred to the ABLEDATA website at http://www.abledata.com/.