CHAPTER 5
BINGHAMTON UNIVERSITY

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COLLAPSIBLE ACTIVITY FRAME

Designers: Jennifer Thurkins, Joel Andrews, Lucas Oracz, Owen Kim
Client Coordinator: Donna Boisvert, Vestal School District (VSD)
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
A school district needed an activity frame, a device to hold visual stimuli for children of varying developmental stages. The device was required to stand above a child who is lying down or seated.

SUMMARY OF IMPACT
The activity frame allows various toys to hang above or in front of a child. It enables a child to have toys within the child’s constant reach.

TECHNICAL DESCRIPTION
The activity frame is constructed of 1 3/8” PVC furniture-grade plastic tubing. This material is both inexpensive and durable. Telescoping tubes with push-button locks make it fully adjustable in height. The device is also foldable via pivoting joints on the end. To fold flat, the top portion is removed, leaving the two inner tubes free to pivot flat.

The final cost of the Activity Frame was approximately $15.

Figure 5.1. Collapsible Activity Frame.
ADJUSTABLE HEIGHT COMPUTER MONITOR

Designers: Aaron Ellis, Marin Jukic, Vinnie Rossi, Nathan Walker
Client Coordinator: Mary O’Dell, BOCES at Appalachian
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
A desk was designed to incorporate a mechanism for holding a computer monitor closer to the students’ eyes, thereby increasing the visibility of computer graphics and text. The device accommodates a wheelchair, which has a higher-than-average desk-top.

SUMMARY OF IMPACT
Many children with visual impairments are unable to use computers. A computer desk that brings the monitor closer to the user is desirable because visibility of the monitor increases proportionally with decreasing distance.

TECHNICAL DESCRIPTION
The frame of the desk is made of pine. The table and walls are made of ½” luan plywood. The desk is high enough to accommodate a wheelchair, yet low enough to allow easy viewing of the monitor. There is storage space for the computer CPU to the left of the user. The desk incorporates a commercial adjustable arm upon which the computer monitor is mounted. This allows users to bring the monitor closer to them. The arm is adjustable to accommodate many users.

Attached to the desk is an internal surge-protecting power supply. With the disconnection of one plug, the computer, monitor, and desk can be moved, on casters, as one piece. The final cost of the adjustable computer desk was approximately $125.

Figure 5.2. A computer and computer monitor stand for the visually impaired children.
INTRODUCTION
A lightweight, portable balance beam was constructed for use by the therapists in a school district. It is 2”x4” in cross section and 8’ long. It folds into four 2’ sections.

SUMMARY OF IMPACT
A portable balance beam is used in several schools. It makes balance beam work more accessible to students and obviates the need to buy a balance beam for each school.

TECHNICAL DESCRIPTION
The device is constructed of a wooden frame made of ¾”x1 ½” stock and covered with ¼” luan mahogany veneer. Eight feet long, it folds into four sections via four hinges mounted within the balance beam. When extended, the beam is long enough for use, but when folded, it fits easily under the arm of the user. A locking mechanism stabilizes the beam in both open and closed positions.

A carrying strap made of conventional backpack buckles and nylon allows for convenient carrying at one’s side.

The final cost of the Balance Beam was approximately $15.
INTRODUCTION
A device was designed to assist people who have trouble transferring themselves into and out of bed.

SUMMARY OF IMPACT
Bed rails are an easy way to help a person get into and out of bed. However, most beds do not have bed rails. A device that mounts to any bed is useful for people who have trouble transferring themselves into and out of bed.

TECHNICAL DESCRIPTION
The device is constructed primarily of 1 3/8” PVC pipe. The vertical post has a piece of steel conduit mounted inside for stiffening purposes. The base of the device is a circular piece of ¾” plywood, with a mounting flange for the PVC pipe.

The device is further supported by a 3/16” PVC panel that clamps to the vertical post and slides under the bed mattress. The panel is vertically adjustable to fit the height of the bed. The lifting handle is rotationally adjustable so that the bed rail assist can be used from virtually any direction.

PVC Slip Tee’s that fit the vertical PVC tube are used to allow for adjustment. The top Slip Tee has slots machined in its bottom edge that fit over the head of a cap screw. This allows the lifting handle to be set at several different positions.

The final cost of the Bed Rail Assist was approximately $20.
CART WITH BASKET

Designers: Michael Spector, Chris Lent, Jason Lewen, Xu An Zeng
Client Coordinator: Terry Terrell, STIC
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
A cart with casters and a removable wire-frame basket was built for a woman who has limited mobility and difficulty carrying hot items from the stove to other locations in the kitchen.

SUMMARY OF IMPACT
Conventional walkers do not incorporate the use of a basket to carry items. This cart, which is equipped with both a basket and casters, allows the client to work in the kitchen without relying on others.

TECHNICAL DESCRIPTION
The cart is constructed of 1 3/8” PVC furniture-grade tubing. The PVC offers an attractive finish, while yielding the necessary strength and ease of assembly required in any project.

The padding on the rear support tube is vinyl over foam, mounted to the PVC frame.

The rear of the cart is free of obstructions. It incorporates a basket for carrying kitchen items and food across the room. The basket is held in a slotted frame so that it can be removed, but will not slide out of position when being used. The 4” casters on which the cart rolls are mounted away from the user’s feet. Two of the casters are lockable.

The final cost of the Cart with basket was approximately $75.


CHAIR ADJUSTMENT

Designers: James Wei, Shan Su, Lindsey Krough
Client Coordinator: Colleen Griffith, Johnson City School District
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INTRODUCTION

Many school chairs are not adjustable to fit small children, especially those with physical disabilities. Standard back supports and footrests often leave children sitting too far from their workspace to provide reasonable access. An adjustable foam back support and adjustable wooden footrest were constructed to fit a standard school chair.

SUMMARY OF IMPACT

A chair with adjustable back support and footrest will help small children.

TECHNICAL DESCRIPTION

The device is made of foam and vinyl construction. The vinyl covers a series of removable thin foam sheets, allowing the vinyl pad to increase and decrease in thickness, thus adjusting the depth of the back support/rest of the chair. A 2” nylon strap with buckle adjustment, sewn into the seams of the vinyl cover, attaches the pad to the back of a regular school chair.

The footrest is constructed primarily of wood with metal screw fasteners. The structure is attached to the existing legs of the chair by way of a clamping mechanism, which is adjusted using two hand fasteners.

The final cost of the Chair Adjustment was approximately $15.

Figure 5.6. School Chair to Accommodate a Small Child.
DOUBLe PEdAL BOARD

Designers: Nnamdi Nwanze, Brian Lamond, Charles Kim, Craig Marcinkowski  
Client Coordinator: Inalou Davey, Rehabilitation Services Inc., (RSI)  
Supervising Professor: Professor Richard S. Culver  
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INTRODUCTION
The Double Pedal Board was constructed for clients who lack balance or have weakness on one side of the body. Patients may use it to gain strength on a weak side, and to gain balance.

SUMMARY OF IMPACT
Many people lack strength on one side of their body or have trouble balancing while standing or walking. The Double Pedal Board allows a person who has unilateral weakness to gain strength. It also allows users with a lack of balance to gain balance by mimicking a motion similar to walking or climbing stairs.

TECHNICAL DESCRIPTION
The main structure of the Double Pedal Board is wooden. The handles are wooden, and are bolted to the main foot pedals, via screws and metal right-angle brackets. These brackets allow the user to put most of his/her weight on the handles without fear of falling.

The device consists of six wheels mounted opposite two pedal boards such that two of the wheels are located between the length of the boards and the other four are located outside of the pedal boards.

When the user presses down on one foot, the device begins to move forward or backward by way of four offset mounting pivots to which the pedal boards are attached.

The handles of the device are adjustable to accommodate the height of many individuals.

The final cost of the Double Pedal Board was approximately $50.
INTRODUCTION
A three-year old girl needed a replacement for a folding chair she had outgrown. The chair accommodates a potty seat, and has a folding mechanism for storage in an automobile.

SUMMARY OF IMPACT
It is difficult to find ergonomic chairs for children with physical disabilities, especially chairs that are comfortable but compact and foldable. This chair can be taken in the car and used for a portable potty as well as sitting chair.

TECHNICAL DESCRIPTION
The main structure is wooden, and has six components: the left arm, right arm, left folding support, right folding support, and front and rear main supports. The six components are hinged so that the chair can fold in one piece. The chair locks into position through the use of two easily adjustable steel straps.

The seat of the chair is removable, and any comparably sized seat may be used, including the potty seat especially modified for this chair (as shown in figure 5.8).

A 2” thick footstool was supplied with the chair to allow for use by smaller children.

The final cost of the folding chair was approximately $25.
HEAD SUPPORT FOR CHAIR

Designers: Raymond Wong, Jake Liu, Brad Bungo, Tom McCabe
Client Coordinators: Colleen Griffith, Johnson City School District
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
Many children with disabilities have difficulty supporting their heads properly. Lack of proper head support can lead to respiratory problems and neck and back difficulties as well as a number of other problems. A school district needed a head support that could be mounted on their existing Trip-Trac chairs. The head support needed to attach to the back of the chairs and be adjustable in height and forward/backward mobility.

SUMMARY OF IMPACT
The add-on head support increases the usefulness of a Trip-Trac chair and makes it accessible to many more people who could otherwise not use this chair.

TECHNICAL DESCRIPTION
The head support was constructed from a music-stand frame. The frame, while lightweight, is adjustable in height, enabling the head support to be used by different people.

The actual headrest connects to the aluminum frame via an adjustable aluminum rod. The adjustment allows the user to sit with his/her head resting at multiple angles.

The device clamps to the existing Trip-Trac chair via three small aluminum clamps designed such that no modification has to be made to the original chair.

The headrest is constructed of foam and vinyl, with a thin sheet of aluminum within for basic structural support.

The final cost of the headrest was approximately $30.
THE HEAD SWITCH

Designers: Tony Huang, Izhar Ahmad, Alok Bhalla, Jason Yuen
Client Coordinator: Beth Peck, ARC Day Treatment Program
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
A head switch was designed to enable a patient to turn music on and off at will without the help of another person.

SUMMARY OF IMPACT
The head switch allows the client to control her music independently.

TECHNICAL DESCRIPTION
The switch is a plastic hinge with a micro switch screwed on to one of the inner sides. As the hinge is pressed, it in turn presses on to the micro switch, activating the circuit. The plastic base is firmly screwed against a half-inch plywood board. The bottom part of the wooden board is fitted with Velcro. A facing Velcro strip is attached to a beanbag. Finally, four parallel slits are drilled and filed into the curved plastic base. Two nylon straps are then inserted through these slits, and two pairs of complementary buckles are attached to either end of the straps. The straps secure the device to the headrest.

The final cost of the Head Switch was approximately $15.

Figure 5.10. Head Switch.
ADJUSTABLE PENCIL GRIPPER

Designers: Mike McCarthy, Tamir Ratzon, David Lomonaco, Hsing-I Lin
Client Coordinator: Bonnie Cole, Handicapped Children’s Association
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
Some young children with limitations in the use of their hands have difficulty grasping small objects such as pens and markers. A hand-held gripper for writing instruments was constructed to address this problem. The handle of the pencil gripper is perpendicular to the writing instrument, which allows the user to lay his or her hand on the table while writing.

SUMMARY OF IMPACT
A pencil gripper enables small children and those with physical disabilities to work more accurately with small writing instruments.

TECHNICAL DESCRIPTION
The gripping portion of the pencil gripper is made from a modified beaker holder. The holder is installed inside a one-inch diameter PVC tube. The thumbscrews used to compress the jaws on the beaker holder are replaced with a heavy rubber band that keeps the jaws closed. A writing instrument is inserted between the two fingers of the beaker holder. The handle is coated with rubber tape for a stronger grip. The device can accommodate writing instruments with an outside diameter from #2 pencil size to ¾ inch.

The final cost of the adjustable pencil gripper is approximately $10.

Figure 5.11. Adjustable Pencil Gripper.
INTRODUCTION
A medium sized puppet theatre was constructed for children with autism. The theatre is portable, yet sturdy, incorporates internal lighting, and has a retractable curtain.

SUMMARY OF IMPACT
The puppet theater provides a unique way for children with autism to express themselves. In addition, this theatre provides wholesome entertainment for many children.

TECHNICAL DESCRIPTION
The main structure is made of pine and ½" birch plywood. Metal cornering brackets provide internal structural stability. The result was a lightweight, sturdy puppet theatre.

The theater has three internal lights, red, green, and blue. Each light, operated with its own switch, allows the users to modify the mood and tone of the theatre.

An adjustable curtain rod with pull cords has been modified to make it possible for the user to open and close the curtains from the rear of the theatre.

The final cost of the puppet theatre was approximately $100.

Figure 5.12. Puppet Theatre.
**SCOOTER BOARD**

Designers: Steven Violante, Derrick Farfan, Rebecca Knowlton, Nova Greenberg  
Client Coordinators: Donna Boisvert, Vestal School District (VSD)  
Supervising Professor: Professor Richard S. Culver  
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**INTRODUCTION**  
A scooter board was designed to enhance students’ mobility. A removable frame with straps allows a child who cannot support himself/herself to ride. It is adjustable to accommodate children of different sizes.

**SUMMARY OF IMPACT**  
Scooter boards are small platforms with wheels mounted on the bottom. Individuals can sit or lie down on the board and push themselves along in any direction using their hands.

This particular scooter board permits the user to operate in either a sitting or lying position, a feature not incorporated in existing scooter boards.

**TECHNICAL DESCRIPTION**  
The device is constructed of PVC, foam, and cloth, as well as ¾” pine board. The pine board serves as the structural mainstay of the device, with the wheels mounted onto the board. The board is divided into two sections combined together using hand tightened wing nuts. The split bottom of the device allows the user to adjust its length.

The back of the device is constructed of PVC and cloth. The PVC acts as the main support, while the cloth, which is stretched taut across the PVC support frame, acts as a backrest.

Also included in the design are multiple nylon straps to secure the user to the device, as well as multiple foam back supports for cases when the user rides in a prone position.

The final cost of the project was approximately $35.

Figure 5.13. Scooter Board.
SIT-AND-SPIN TOY FOR LARGER CHILDREN AND ADULTS

Designers: Kristen Beal, Eric Stellrecht, Kevin Stein, Stephanie Deckter
Client Coordinator: Donna Boisvert, Vestal School District (VSD)
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INTRODUCTION
A Sit-and-Spin toy was designed for use by larger children and adults. Similar toys on the market are too small and are made of plastic materials that fail under loads of larger children and adults.

SUMMARY OF IMPACT
A Sit-and-Spin is a fun toy that enhances hand-eye coordination and upper body strength.

TECHNICAL DESCRIPTION
The device is constructed of luan mahogany plywood, PVC tube, an extra large commercial thrust bearing, and plastic casters with metal frames.

The main platform of the device is constructed using the plywood. Underneath the main platform are mounted four casters, with their line of travel tangential to the circular base. While the casters relieve some of the load on the base of the Sit-and-Spin, the use of a thrust bearing was deemed necessary for smooth operation. Thus in the center of the main platform a thrust bearing is mounted to disperse most of the load in the center of the toy while providing a smooth rolling motion. The center shaft of the device is constructed of PVC tube. A simple bolt mechanism and holes along the center shaft allow for easy adjustment of handgrip height.

The final cost of the Sit-and-Spin is approximately $90.

Figure 5.14. Sit-and-Spin Toy for Larger Children and Adults.
STAND-PIVOT SYSTEM

Designers: Vincent Lee, Matt Yavorsky, Christopher Yatrakis, Peter Joo
Client Coordinator: Valdo Rogers, Broome Development Center
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
A stand-pivot system was designed to easily and safely transfer clients to and from wheelchairs and beds. The Broome Development Center works with many people who have difficulty transferring from a wheelchair to a bed. The difficulty increases when the individual has limited control of his/her legs. The individual’s feet often bind on the floor during the rotation that takes place in the transfer.

SUMMARY OF IMPACT
The device, a flat freely-spinning disk mounted close to the floor, enables the easy rotation of one’s body to facilitate the safe transfer of individuals to and from wheelchairs and beds.

TECHNICAL DESCRIPTION
The device is constructed of 3/16” PVC plastic sheeting (Figure 5.15). Two pieces of this strong yet flexible material are mounted together using standard commercially available thrust bearings.

The bottom and top surfaces of the device are coated with non-slip tape to further enhance the safety of the device.

The final cost of the stand-pivot system to transfer clients to and from wheelchairs and beds was approximately $17.

Figure 5.15. Stand-Pivot System.
FLOTATION BELT

Designers: Todd Young, Miheer Fyzee, Catherine Ma, Erica McKenzie
Client Coordinator: Colleen Griffith, Johnson City School District
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
A buoyancy system was designed to allow a client with cerebral palsy to be held at the correct orientation and with the minimum buoyancy needed to maintain proper swimming form.

SUMMARY OF IMPACT
The flotation belt replaces an improvised swimming belt that was unsightly and difficult to use. This belt is attractive and easy to adjust. It has contributed to the client’s progress in a special swimming program.

TECHNICAL DESCRIPTION
The device, designed for children with cerebral palsy, is mainly composed of nylon and Styrofoam. Two straps with adjustable buckles allow the device to be used with a wide variety of children.

The device is also adjustable in other ways. Multi-part Styrofoam pads that slip into the nylon allow any number of Styrofoam pads to be used to adjust the flotation of the device for children of various weights. Also, the straps can be adjusted to hold the device at different positions on the user’s torso.

The final cost of the swimming aid was approximately $15.

Figure 5.16. Flotation Belt.
TABLE FOR BENNETT BENCH

Designers: Will Wojtkielewicz, Robert Polak, James Gale, Patrick O’Meara
Client Coordinator: Inalou Davey, Rehabilitation Services Inc., (RSI)
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
The Bennett Bench is a device for exercising bimanual manipulation skills. A lightweight, rigid, adjustable table was built so that more people with disabilities can use the Bennett Bench equipment.

SUMMARY OF IMPACT
The adjustable Bennett Bench table provides much needed access to the Bennett Bench for people who currently cannot use it due to height restrictions. The adjustable stand allows different users to use the Bennett Bench.

TECHNICAL DESCRIPTION
The frame of the Bennett Bench table is made of 1 3/8" furniture-grade PVC tubing. Incorporating telescoping tubes, the frame is adjustable to accommodate varying heights of sitting and standing users. The bottom of the table uses PVC end caps to ensure stable footing. The table surface is ¾" luan mahogany plywood.

The final cost of the Table for Bennett Bench was approximately $40.

Figure 5.17. Adjustable Table for the Bennett Bench
INTRODUCTION
The differing heights of wheelchairs make it difficult to tailor workstations for multiple users. A sheltered workshop needed a multi-user station to accommodate many individuals in wheelchairs of varying heights.

SUMMARY OF IMPACT
The device enables people with different working heights, due to varying wheelchair sizes, to work on the same workstation.

TECHNICAL DESCRIPTION
A four-person desk-type unit allows each person to work at a different height. Each desk incorporates boxes for storage, located on the top of the unit, as well as an adjustable wooden tabletop. The tabletop was mounted on commercial, adjustable steel shelving brackets similar to those used for bookshelves.

The structural frame of the device was designed to be easily collapsible if the need for low-space storage arises. It is made out of clear pine lumber. The feet are foldable, and the shelves are easily removed as well.

The final cost of the device was approximately $80.
WHEELCHAIR STORAGE RACK

Designers: Yassir Hussain, Jared Miller, Jae H. Park, Tim Schlauraff
Client Coordinators: Valdo Rogers, Broome Development Center
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
A storage rack was built to support eight wheelchairs. It allows for easy access to the wheelchairs and eliminates damage due to haphazard stacking.

SUMMARY OF IMPACT
Wheelchairs are costly and difficult to repair. Proper storage of these essential devices is necessary to preserve and maintain them. This rack represents a major improvement to the management of wheelchairs at a developmental center.

TECHNICAL DESCRIPTION
The device, designed to meet strict fire code requirements, is composed entirely of steel fence posting. Strong and lightweight, this material is both functional and aesthetically pleasing.

The device consists of basic box-frame construction, with joints composed of standard fencing elbows. The rack has three horizontal rails. Two rails hold the large rear wheel, while the third, which is slightly higher than the other two, supports the wheelchair frame behind the small front wheel.

The device, while relatively compact, can store up to eight wheelchairs: four on top, and four below.

The final cost of the wheelchair storage rack was $283.

Figure 5.19. Wheelchair Storage Rack.
FOOT-PROPELLED WHEELCHAIR

Designers: Philip Suarez, Vincent Look, Joel Almonte, Robert Bracero
Client Coordinator: Terry Terrell, STIC
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
The foot-propelled wheelchair was built for an elderly woman with cerebral palsy who prefers to propel herself with her feet. Her existing wheelchair was in disrepair and did not allow easy foot movement.

SUMMARY OF IMPACT
A wheelchair with free space for feet allows the user to propel herself without using her hands. This new wheelchair improves her mobility and is an attractive alternative to the one she was using.

TECHNICAL DESCRIPTION
The wheelchair frame is constructed of 1 3/8" furniture-grade PVC tubing. The PVC offers an attractive finish, while incorporating the necessary strength and ease of assembly required in any project.

The padding of the chair is vinyl over foam, which is supported on the PVC frame with 3/8" plywood.

The front of the chair is free of obstructions, unlike conventional wheelchairs, and the casters on which the chair rolls are mounted away from the user’s feet.

The two rear casters are lockable and are frozen so that they only track forward.

The final cost of the Wheelchair is approximately $60.

Figure 5.20. Foot-Propelled Wheelchair.
INTRODUCTION
An adjustable walker was designed for children with developmental delay.

SUMMARY OF IMPACT
A walker device was needed to help children maintain their balance while walking. The multiple-use stabilizing device can be used by children of varying sizes. Varying amounts of tension can be placed on the wheels to match the child’s ability. The resistance can be lessened as the child gains strength and walking skills. This allows for a gradual progression of becoming less dependent on the walker. Once the child masters the coordination that is required to walk with no tension, the swivel lock can be disabled to allow the child to learn how to change directions. The walking process is simplified into manageable and yet challenging steps that can be isolated and then mastered.

TECHNICAL DESCRIPTION
The children’s walker was designed to be used by more than one child. Therefore, many of the features of the walker are adjustable. The main requirements were that it: 1) support the weight of a child up to 50 pounds, but not provide so much support that the child would become dependent upon the device; 2) be lightweight enough so that it is portable and maneuverable; 3) be durable and easy to maintain; 4) allow enough room for the child to walk behind it with a 12” wide clearance for feet; 5) have a handle of about ¾” diameter with a height adjustment range of 1½’; 6) work on both hardwood floors and carpet; 7) have adjustable wheels resistance; 8) have a steering and rigid mode as well as wheels which only roll forward; 9) permit any adjustments to be made in under five minutes; and 10) be safe.

The walker has a 20”x20” U-shaped base with two 20” posts rising from the middle of the two long sections of the U. These posts are secured to the base and the handle is mounted to the two posts. Four pivoting casters are mounted to the corners of the U. The entire frame is constructed from ½” furniture grade PVC piping. Slip Tee and internal elbow fittings are used to join the members of the frame. Holes in the posts at 1” spacing allow vertical adjustment of the handle. The handle, constructed from ¾” PVC tubing, is screwed into Slip Tee joints, which fit over the posts.

The two rear 2” casters do not pivot. A screw can be forced against the surface of the caster to provide adjustable resistance and can be used as a stop when screwed all the way down.

The two front swivel 2” casters feature a swivel lock, which allows the wheels to have a rigid and a steering mode. In order to create this device, a ½” thick aluminum block was cut in a C-shape, which fits snugly around the wheels. A hinge connects the caster mounting plate to the aluminum block. This allows the block to rotate down onto the wheel and lock it in a fixed position, or to rotate up and allow the wheel to swivel freely. An elastic band holds the block in place when the caster is allowed to pivot.

The total weight of the device is 8.7 pounds.

The cost is $67.00. A similar device is available on the market, but not with all of the features that this walker offers for such a low price.
Figure 5.21. Adjustable Walker.
AUTOMATIC ROCKER FOR AN EASY CHAIR

Designers: Jared Waugh, Ricky Lu, Ariel Reiter
Client Coordinator: Valdo Rogers, Broome Development Center
Supervising Professor: Richard S. Culver
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INTRODUCTION
An automatic rocker was made for a twenty-year-old man with autism. It fits under the lower rear edge of an overstuffed rocking chair. It consists of a rotating arm on a small gear motor, mounted in a frame that sits on the floor. When operating, the rotating arm pushes up on the seat through a rolling bearing.

SUMMARY OF IMPACT
Previously, the client’s caregiver found that when he rocked the chair with his foot, it calmed the client. The Automatic Rocker relieves the caregiver of having to rock the chair.

TECHNICAL DESCRIPTION
Measurements of the range of motion of the chair and the natural frequency of the rocker indicated that the vertical travel is 3” at a frequency of approximately 39 rpm. The maximum vertical force required to obtain this displacement is 20 pounds. Using this information, a gear motor, which runs at 35 rpm and has a maximum torque rating of 30 inch-pounds, was selected. The motor is attached to a 5/8” plywood frame, which extends under the chair. A 1/2” diameter shaft extension is mounted on the motor. The 2” aluminum crank arm supports another 1/2” shaft at a distance of 1 1/2 “ to provide the needed vertical motion. A 3/4” diameter PVC sleeve which slips on the crank provides a moving bearing to reduce friction between the bottom of the chair and the rotating arm.

Because of the geometry of the system, the maximum vertical force of 20 pounds is applied when the crank moment arm is of zero length. The maximum applied torque occurs at 45° above horizontal. It is calculated to be about 10 inch-pounds, which is well within the capacity of the motor, particularly since the motor only applies this torque for a small portion of each rotation.

The motor assembly has a wooden cover, with metal screen ends to allow for ventilation.

The total cost of the automatic rocker is $75.
Figure 5.22. Automatic Rocker for an Easy Chair.
CLIMBING WALL FOR YOUNG CHILDREN

Designers: Brian Ide – Junior, Matthew DuBord, Jason Borgen, Daniel Roesser, Allan Assuncion
Client Coordinator: Laura Cline, Handicapped Children’s Association
Supervising Professor: Richard S. Culver
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INTRODUCTION
An adjustable climbing wall was constructed for use by children. Eight feet high and 6 feet wide, it is attached to a tubular steel frame, which allows it to be set at different angles. A variety of handles and handholds are provided on the face of the wall to assist children in climbing on it. A horizontal bar at the top of the wall provides an anchor for a climbing rope, which is attached to a climbing harness on the child. The frame is designed to allow one or two therapists to be on the wall with the child to assist in climbing. The wall surface is covered with linoleum to provide a smooth surface that will hold plastic-based stick-on cartoon characters, enhancing motivation for climbing.

SUMMARY OF IMPACT
Climbing walls provide an ideal activity for children with limited physical ability to stimulate hand/eye coordination and to build upper body strength. The climbing wall takes up much less space than a jungle gym and provides a single controlled surface upon which a child can exercise. Its flat surface provides a convenient means for the therapist to provide active support while the child is climbing.
TECHNICAL DESCRIPTION

The climbing wall surface is made of two 4’x 6’, ¾” plywood panels. Holes 5/8” diameter, are drilled in the panels in a regular pattern to provide anchor points for the handholds. Footholds are also cut into the surface of the wall. The wall is covered with a tan, pebble-patterned linoleum that resembles a rock wall.

The panels are mounted on a moving frame made from 1”. square tubular steel. Three-inch casters are mounted on the bottom of the frame. A ½” steel rod runs across the top of the frame and extends past the end of the frame an additional inch to provide the upper sliding anchor. Plastic tubing on the rod provides the sliding surface. The matching steel tubular frame attached to the wall has a steel L-shaped angle welded to the side to provide a channel for the plastic covered anchors. Eye-bolts attached to the lower extremities of the fixed frame on the wall and the moving frame are used to anchor a heavy-duty steel chain which allows the wall to be supported at different angles from the wall.

Two types of handgrips are used. Children’s’ tricycle handgrips are slid onto 5/8” bolts protruding through the wall. Wooden handgrips made from lumber and covered with fiberglass are also used. The fiberglass resin was dipped in sand when wet to make a nonslip surface. A 5/8” bolt attaches the handgrips to the wall. These can be moved around the wall to create the desired climbing pattern.

The cost of materials for the climbing wall is $275.
COLLAPSIBLE CANE FOR THE BLIND

Designers: James Keane, John Nenadic, Dave Allen
Client Coordinator: Dave Scudder, Intellidapt
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
A new design was developed for a collapsible cane for individuals with blindness. Joints using a metal hinge with a bungee cord running through the center replace the traditional slip joint.

SUMMARY OF IMPACT
Commercially available folding canes for use by individuals with blindness are made of aluminum tubing. One end of each tube is reduced in cross section so that it fits inside the next tube. An elastic bungee cord runs through the entire cane to pull the individual tubes together. In use, the sharp edge of the tube can eventually cut through the bungee cord. Also, the tube joint often becomes loose from repeated assembly and bending. The joints are not strong. If loaded laterally, the joints can bend or open up. The cane built in this project uses a more robust joint, which works in a manner similar to the traditional cane. In a field trial, someone accidentally stepped on the cane, but it did not break, confirming the strength of the joint. This cane design will permit longer use and more user confidence than current commercial models.

TECHNICAL DESCRIPTION
One side of the yoke and tongue hinge can slide out while the other is fixed. The elastic bungee cord that holds the joint together when assembled passes through the hinge pieces. To operate, the user pulls the two tubes apart, stretching the bungee cord. When the hinge joint is clear of the nesting tube, it can be folded. The joint parts are made of aluminum, as is the shank of the cane. The cane tubular wall was reduced in thickness between joints in order to reduce the weight of the cane. This cane weighs approximately the same as commercial canes.

The cost of materials was approximately $25.
Figure 5.27 – Joint on Collapsible Cane.
ELECTRONIC LOCK

Designers: Abraham Howell, Dariusz Filak, Jose Tova
Client Coordinator: Colleen Griffith, JCSD
Supervising Professor: Professor Richard S. Culver
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INTRODUCTION
An electronically operated lock system was designed and built to attach to a regular locker door.

SUMMARY OF IMPACT
The client is a 13-year-old female middle school student with cerebral palsy. She could not open her school locker due to her limited manual dexterity with the combination lock. The electronically activated rotary lock system allows her to open the locker on her own from her wheelchair.

TECHNICAL DESCRIPTION
An actual locker door was removed from its frame to facilitate installation. The handle was removed and new holes were drilled to allow for the mounting of a tubular solenoid actuator. A receiver and transmitter from Power Door products provide the electronic control for the lock. When the small, handheld transmitter sends a signal to the receiver, a relay in the receiver is closed. The relay sends power to the 12-volt door actuator, which opens the rotary latch.

The receiver requires 24 volts and the solenoid actuator, 12 volts. Transformers to provide these voltages are mounted in the ceiling and attached to a 110-volt duplex outlet.

All sharp edges are removed from the door and lock fittings to prevent injury. The handheld transmitter is mounted with Velcro to the client’s wheelchair. The transmitter has a large button.

The final cost of the Key Lock Mechanism is approximately $175.
INTRODUCTION
A commercial four-wheeled pedal car was modified for use by elementary school students. The car has an adjustable seat and a PVC body that folds back to permit easy access.

SUMMARY OF IMPACT
A pedal car was designed for students to use in physical therapy and recreation programs. The school was unable to afford an equivalent commercially available vehicle. The students vary in ability, size and weight (from 4'6" to 6' and from 100 to 250 pounds). The car allows several students to ride on the playground.

TECHNICAL DESCRIPTION
For safety reasons, a commercial frame was used. It was purchased from Quadracycle, in Hamilton IN.

Made of rectangular steel tubing, it is designed for a single rider and has a regular steering wheel and hand brake. It has 16" balloon tires. Local fabrication involved the design and construction of a PVC body, attached to the frame with hinges and latches. PVC sheet, 1/8" thick, was hand formed using a heat gun. The shape of the body is carefully designed to permit use of straight bends. The hood is mounted with hinges so that it can be raised to assist the driver in entering the car.

Upon completing the construction, the body was spray-painted racing green.

Cost of the pedal car is $495. The PVC plastic sheet, fittings and paint cost $70. The total cost of materials is $565.
POOL LIFT FOR SMALL CHILD

Designers: Matthew Rubin, Christopher Conklin, David Wong
Client Coordinator: Judy Zeamer, High Risks Birth Clinic
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INTRODUCTION
A fiberglass seat, which can be lowered by hand into a swimming pool, was made for a four-year-old girl with cerebral palsy. The seat is attached, by pivoting arms, to a PVC tubular frame that is clamped to the wooden deck surrounding the swimming pool. In use, the girl is strapped into the seat at the poolside. The seat is then lifted by a bar (molded into the top of the chair) and rotated until it is over the water. The seat is then lowered into the water. A clamp on the vertical guidepost controls the depth of submersion.

SUMMARY OF IMPACT
The client's use of the pool had been limited because she cannot support herself in an upright position. The lifting mechanism makes it possible for her parents to easily lower her into the water. The lift provides a safe means by which the client can enjoy the water and participate in water play with her friends.

TECHNICAL DESCRIPTION
The pool lift is made from PVC plastic tubing and fiberglass. The seat is formed from fiberglass, using a wooden frame, molded around two PVC tubes, which connect the seat to the supporting frame. On the end of the two horizontal PVC tubes, Slip Tees are held with bolts. These Tees allow the seat to move vertically and rotate around the main vertical post. The main post consists of a PVC tube with an internal steel electrical conduit and spacer for stiffening. On the bottom of the conduit is a 16-pound steel disk that anchors the post to the pool bottom. The disk and conduit are coated with rubber to prevent rusting. The top of the vertical post is attached to a PVC frame that is bolted via a PVC flange to the wooden pool deck. The supporting frame is attached to the vertical post using slip joints with spring buttons so that the post can be removed for storage.

The frame and seat cost approximately $90.
Figure 5.30. Pool Lift.
PORTABLE SWIMMING POOL STAIRS

Designers: Jason Mooney, James Bush, Jonathan Curtin

Client Coordinator: Sheila Zuba, Johnson City YMCA

Supervising Professor: Richard S. Culver

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INTRODUCTION

A portable stairway was designed and built to provide access to a swimming pool for people with limited mobility.

SUMMARY OF IMPACT

Many of the participants in an active water therapy program for senior citizens are heavy and have difficulty getting into and out of the pool. The portable steps previously used were very steep. Rising above the pool level, they were especially difficult to negotiate. An expensive commercial pool stairway system had been purchased but did not work. The stairway built in this project is so popular that people were upset when it was removed for refinement.

TECHNICAL DESCRIPTION

The pool stairway is constructed from 2" x 6" fiberglass channel. The channel is used for the side runners and double width channels form the steps. The actual rise for each step is 6". By hooking the stairway to the rolled stainless steel edge on the pool with a matching stainless steel lip, it was possible to minimize the number of steps. The stairway has to fit between the end of the pool and the permanent ladder, which is about 8' from the end of the pool. The steps are attached to the runners with flanges made from channel material. A 3/4" diameter PVC tube is mounted to the bottom of each runner to provide a skid to assist in lowering the stairway into the pool. The stairway is painted bright yellow with epoxy paint.

When the stairway was completed, it was found to be stiff enough in bending but had low torsional rigidity. Plexiglas panels were thus mounted between adjacent steps as stiffeners. This significantly improved the rigidity.

Figure 5.31. The Pool Stairway in the Water.

Figure 5.32. Pool Stairs on Deck.
The rails are made of reinforced furniture-grade PVC tubing. Steel electrical conduit with spacers is placed in each vertical support. Threaded aluminum joints were matched to the conduit to provide longitudinal stiffening in the lower horizontal rail. The rails are attached to the side of the stairway using PVC Tees.

The stainless steel lip, which holds the stairway to the edge of the pool, was made commercially from 20-gauge sheet. When the steps were installed, it was found that the lip slowly deformed under load and unwrapped from the pool edge. The lip was rerolled and a PVC frame was constructed to sit under the uppermost step on the stairway. When the lip slips approximately 0.05" under load, the frame takes the load. This insures that the lip is tightly attached to the edge so that it will not slide sideways.

Total cost of the pool stairs is $975.

Figure 5.33. Attachment of the Handrail to the Stairway Frame.
INTRODUCTION
A Pressure Vest was designed for young children with autism. The device is mechanical. The child places the vest around his/her torso and applies pressure by rotating a hook, which then pulls the front of the vest together. Studies have shown that this type of pressure technique may be therapeutic in some cases. The interior of the vest is made of foam and steel ribs, surrounded by canvas on the exterior. The ribs provide rigidity. The child controls the device, but is under adult supervision at all times.

SUMMARY OF IMPACT
Deep pressure therapy is sometimes used with the intent to satisfy the need of individuals with autism for tactile stimulation. Pressure is slowly applied over the individual’s body for a calming effect. Experts consulted were clear that this method of treatment is not a universal solution to the needs of individuals with autism. Although the vest provided the desired pressure on a small child, use was discontinued because of the risk of causing internal injury. Without appropriate feedback there is no effective way to protect the child.

TECHNICAL DESCRIPTION
The dimensions of the vest were based on measurements of average three- to five-year-olds in a local preschool (24” (± 3”) around the waist, and 10½” (± 1”) from armpit to hip). The vest is 30” in length when laid out flat, and 10” high.

The tightening/pressure applying mechanism consists of a hook and a hitch (Figure 5.33), made from aluminum and mounted directly on the ribs of the vest. The handle on the hook has a swivel knob for easy operation. There is an overlap on the back of the vest in order to make the vest adjustable to fit children of differing sizes.

The supervisor puts the vest on the child and inserts the part of the hook with a constant radius onto the hitch. Then the supervisor tightens the buckles in the back of vest to fit the child, and immobilizes the child with the winch strap. Next, the child rotates the handle to increase or decrease the pressure. To get out of the device quickly, the child may simply rotate the handle all the way back until the hook comes out of the hitch.

The total cost of the vest was approximately $165.00. The majority of the cost was for tailoring expense.

Figure 5.34. Pressure Vest showing rear adjustment straps.
Figure 5.35. Pressure Vest with Adjustable Mechanical Latch.
BLOW-STRAW UNIVERSAL REMOTE CONTROL

Designers: Daron King, David Peek, Roger Richardson
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INTRODUCTION
A universal remote control device was designed to accommodate the needs of a client with quadriplegia who is visually impaired. The remote consists of two modular components, the frame and the remote box. The frame is H-shaped, consisting of two bases with vertical posts, and a cross-member that holds the remote box in place. The cross-member is composed of two parallel bars, which are offset horizontally, and slip joints, which connect the cross-member to the vertical posts. The cross-member is adjustable in height and also removable for storage. The remote box consists of four input straws and an output display. Desired results are achieved by blowing or “puffing” through the insert straws. The output display consists of two series of large, colored LED lights, which illuminate in conjunction with the device’s functions. The colored lights are used to accommodate the vision impairment, since text labels are unreadable. The remote allows the client to operate a television, cable, radio, and CD player through infrared light. Four additional devices can be added.

SUMMARY OF IMPACT
The blow-straw remote is a relatively inexpensive and versatile device that provides individuals with quadriplegia the freedom to change their environment even when they are alone. The ability to connect additional devices to the remote in the future will allow the client to continually expand his/her environmental interaction and control.

TECHNICAL DESCRIPTION
The blow-straw remote was designed to accommodate a particular client, but could be used by almost anyone who is seated upright in a chair or recliner. The design constraints presented specifically by our client were that it: 1) be operational without using any body motion except head movement; 2) not use...
text labels or displays, due to the client’s poor vision; 3) be adjustable such that it will accommodate a variety of different chairs that the client may choose to sit in; 4) be universal and able to adapt to new audio/video equipment; 5) not require assistance at any point beyond its initial set up, because the client is alone for most of the day; and, most importantly, 6) be safe.

The frame for the remote control is H-shaped, and has two vertical posts with bases and a cross-member. The vertical posts are two 40" tall 1½“ PVC members, anchored by aluminum bases. The bases are cylindrical, each 12” in diameter and 1” thick. They are mounted to the posts using steel flanges and four bolts. These members are connected to the posts by four 45-degree elbows and short PVC extensions, which lead into two modified “slip V’s”, one on each post. PVC platforms and rubber stoppers, in conjunction with hose clamps, are used to adjust the height of the slip V’s. This allows the height of the cross-members to be finely tuned as opposed to being adjustable in increments.

The remote box was built using 1/8“ thick sheet PVC and assembled using L-brackets and mounting hardware. The final box dimensions are 10” x 14” x 4”. Sheet PVC is also used to wall off two separate compartments in the box, one that holds the remote’s circuitry, and another that houses the blow-straw switches. This is a safety feature to prevent moisture from coming into contact with the circuitry.

Two access doors are built into the box, one to access each compartment. The remote circuitry is from a retail universal remote control with logic gates that decipher input from the blow-straws. The blow-straws are ¼”-diameter tubes that lead into the box and into a larger air diffuser. A plunger in the diffuser depresses a switch when the client blows on the tube. These switches are wired into the remote circuitry in the other compartment.

The remote box is attached to the cross-member by four custom made U-mounts that permanently attached to the bottom of the box. These mounts snap over the cross-members and hold the box in place, while allowing the box to be easily removed or slid across the cross-members. A large digital clock is also mounted on the cross-members using a sheet PVC platform and two custom made U-mounts.

For safety reasons, all edges on the remote box and frame were filed and/ or rounded. Also, 1¼“ PVC caps were mounted on the tops of both vertical posts. The caps enhance the frame’s appearance and cover the rough edge of the open-ended PVC members. A client with quadriplegia tested the frame and box for use and found the apparatus to be effective. It has been suggested that we also install vents in the blow-straw compartment of the box to avoid moisture accumulation and improve safety.

A 7.5V AC/ DC adapter powers the circuitry of the logic circuit. Using a low voltage DC source decreased the chance of shock or electrocution. The universal remote circuitry is powered by two AA batteries, which also have a minimal shock potential. The digital clock is a separate unit, powered by a standard AC plug. The clock does not constitute an electrical hazard.

The final cost of the remote device is approximately $115.00, not including labor charges. Many of the components were made from scrap materials available at no cost.
INTRODUCTION
A wheelchair swing (Figure 5.38) was designed for children with disabilities. The swing moves in a parallel motion to the floor and is powered by human force at the present, but can be modified in the future to accommodate other power sources. The unit was built to be easily disassembled and stored.

SUMMARY OF IMPACT
The wheelchair swing provides clients new opportunities for stimulation and recreation during their indoor classes. It was designed for school-age children, but could be beneficial to others.

TECHNICAL DESCRIPTION
The main design requirements were that the wheelchair swing: 1) be as small as possible, due to the limited amount of classroom space; 2) be portable, easily disassembled and stored out of the way; 3) accommodate all sizes and types of wheelchairs; 4) be safe to use.

The swing has two main components, the frame and the platform. The frame is a rectangular structure consisting of 1 5/8" steel conduits connected with cast aluminum fittings. These structural pipe fittings secure the pipe via allen bolts. Connected to the frame are two 1/8" plastic coated steel cables to stabilize the swing during motion. The platform is a 30" x 50" x 3/4" piece of plywood reinforced with steel and connected to four supporting 1/8" plastic coated steel cables for stability. Connecting the cables are 1/8" cable clips, 3/8" spring snaps, and 5/16" eyebolts. The clips allow for quick disassembly. There is also a small railing on the platform and tie-down straps on the platform to immobilize the wheelchair to the platform. A small ramp has been attached to the platform to load and unload the client.

Tests of the swing were conducted by having members of the design team weight the platform to the simulated weight of the clients while the swing was in motion. A design change for the future is to develop a freestanding swing that is portable for indoor and outdoor use. The swing might also be motorized.

The final cost of the wheelchair swing was approximately $165.
Figure 5.38. Wheel Chair Swing.