INTRODUCTION
A client who has muscular dystrophy is able to work from home and is able to move about his house without a caregiver’s assistance or the continual use of his wheelchair or walker. However, his disability is progressive, and he anticipates having to use his wheelchair more frequently in the future. His wife will provide some assistance, but she is not always available. This system will provide access to his back yard, where he spends most of his days writing.

The house and path to the back garden are narrow. The only available entrance is accessible via steps from ground level to an elevated front porch shared with his neighbor. There were many challenges to creating a system (Fig. 12.1), including the narrowness of the side yard, existing steps at the side of the house, landscaping, an air conditioning unit, building codes, leasing agreements, and the client’s desire to have unobstructed access to the back courtyard.

A chair lift was considered, but could not be installed because it would infringe on the neighbors’ access to their adjoining home. Another concern was power outages due to inclement weather. A back-up power system would be necessary, increasing cost and introducing additional maintenance issues. Two ramps at the side entrance of the house provide the best solution for entry into the house and access to the outside garden. There was insufficient space for one ramp with a ground level pathway beside it.

SUMMARY OF IMPACT
The client may enter and leave his home unassisted with much less difficulty than before. The ramp system is aesthetically pleasing and occupies space that was previously unused. A secondary means of egress as well as additional recreational space are provided. The client stated, “This ramp and deck have really changed lives for the better. I can get into my house much faster and my wife doesn’t have to spend her time spotting me as she did when I used the steps.”

TECHNICAL DESCRIPTION
Fig. 12.2 illustrates the narrowness of the space available, including the neighboring firewall, as viewed from the courtyard. As depicted in Fig. 12.3, the accessibility solution consists of a ramp from the front of the house with a grade of 1:12 to a small intermediate deck located at the side entrance of the
house, to a more steeply graded 1:6 ramp with a railing leading to the back courtyard.

A steeper grade was required for the back ramp to preserve the existing landscaping and to permit access to an air conditioning unit. The client is able to negotiate both ramps in his wheelchair or walker, unassisted. His wife can more easily assist him on the ramps than on the front steps.

The system was built of pressure-treated pine and fastened with galvanized carriage bolts and screws. It can be disassembled if needed and any future additions can be easily added. The posts are made from 4” x 4” supports and the decking from 5/4” x 6” wood. The railings are made of 1.5” x 1.5” balusters and 2” x 4” supports. A sturdy railing surrounds areas of the deck and ramp system not bound by walls. A bumper curb prevents any collision with the railing should the client lose control of his wheelchair. The existing concrete side steps were left in place and used to partially support the deck stringers. The ramps and deck were constructed in nine modular pieces bolted together, which allow individual sections to be disassembled. City building codes classified this structure as temporary. The landlord agreed to the reversible installation.

The total accessible surface area is approximately 170 ft². The deck area is 72.5 ft²; the long ramp is 59 ft², and the short ramp is 37.5 ft². The approximate strength of the structure is 86-lbs/sq ft live load. A limit of four persons per section is recommended to ensure an appropriate factor of safety.

The cost of this project was $2344.
ELEMENTARY SCHOOL COMPUTER LAB ACCESS RAMP

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INTRODUCTION
A client has congenital amyoplasia, a degenerative muscle disease in which muscle tissue is progressively replaced by adipose and fibrous tissue. She is unable to use her arms or legs. She can shrug her shoulders and move her head. She controls her wheelchair using her head and mouth. Her school’s computer lab is located in an outbuilding classroom without wheelchair access. Lift systems are too costly and no continued lift maintenance would be available. A ramp and deck system was most appropriate. Space limitations required that the ramp and deck double back to an unused door.

SUMMARY OF IMPACT
The ramp and deck system permit the client safe and easy access to her computer laboratory, greatly improving her educational experience. Her teachers say that she will be able to participate with her peers in one more school activity. The system was constructed to be compliant with ADA specifications.

TECHNICAL DESCRIPTION
For durability and strength, pressure-treated southern pine and stainless steel connectors were used. The ramped portions of the system were treated as posts and were cut at an appropriate length to provide the required grade in the space available. The posts stand on pre-cast concrete footers. The joists were placed 24” apart, allowing four 2” x 6” joists to support each deck landing. Three such joists were spaced 21” apart for each ramped section. The ramp posts were placed at 6’ intervals. The posts for the landings were spaced at 4’ or 5’ intervals. The ramps were constructed in sections so that the system can be disassembled and easily moved.

The total cost of the materials was $2,350.
Fig. 12.5. ADA Construction Requirements and Ramp Design.
INTRODUCTION
A preschool student with congenital amyoplasia cannot support her upper body without assistance. She and her therapist requested alterations to an existing adaptive chair. These alterations included replacing the casters, adding a footrest, adding a storage bag, developing a head pointer, upgrading the cushions and upholstery, relocating the seatbelt to a more comfortable position, and making it aesthetically pleasing for a five-year-old in a preschool environment.

SUMMARY OF IMPACT
The client said that she was comfortable. She was able to color using the head pointer. The therapist reported that it was an improvement from the old one, and the client was enjoying the new chair.

TECHNICAL DESCRIPTION
A Kaye Kinder Chair was adapted for classroom use. Four new casters were fastened to the chair and the back two were equipped with brakes. The overall height of the chair was not altered so that it would still fit under the preschool classroom tables. The casters were attached to two finished pieces of ¾” birch plywood. The plywood was then attached to the legs of the chair using hinges that serve as self-adjusting angle brackets.

A footrest made from birch plywood with rounded edges was added. Polyurethane was used to seal the edges. A non-slip surface was added to the top to minimize the risk of slipping. The footrest was

Fig. 12.6. Front and Rear Views of Modified Classroom Chair.
attached by L-brackets to the chair using four wingnuts to permit adjustment.

A storage bag was hooked to the back of the chair using grommets. The bag was made from a durable fabric treated with Scotchgard® and was also removable and machine-washable. A Dora the Explorer patch was added to make the bag more appealing to the client.

The cushions are double the thickness of the client’s previous seat and are contoured to provide optimal comfort. The bottom cushion is sloped back to help the client stay in her chair. The back cushion conforms to her upper body. The seat cushions are made of 2-inch-thick foam and were molded by adding layers along the appropriate edges. The cushions were attached to a piece of birch plywood and then upholstered with sturdy vinyl that can be wiped clean with a damp cloth. The cushions are covered with vinyl for protection. Pink slipcovers were made to go over the upholstery. The slipcovers were treated with Scotchgard® and are machine-washable.

Because new seats were attached to the seat cushions, it was necessary to create a new seatbelt. The seatbelt was made of 2” nylon webbing. It is adjustable and has a side-release buckle. It was attached to the seat back using two grommets to reinforce the webbing on each side, and then bolted to the wood. Acorn nuts cap the bolts.

The head pointer allows the client to access a computer and to draw by translating her head movements onto paper. Markers were attached to the end of the head pointer using Velcro. The head pointer was constructed using nylon webbing and a wooden dowel. The head webbing was made adjustable in circumference by using Velcro. A strip of nylon was attached across the top of the head from ear to ear to help support the weight of the pointer. The pointer itself was sewn into the nylon webbing and has a rubber tip at the end. The pointer was shortened to an appropriate length upon delivery.

The total cost of the parts and supplies was $58.
SPOON SUPPORT AND ORIENTATION DEVICE

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INTRODUCTION
A feeding device was designed for a ten-year-old girl with cerebral palsy. She has limited control of her arms, which makes feeding herself difficult. The goal was to promote her ability to feed herself with minimal assistance. Previously she used a self-leveling spoon and a lipped plate to feed herself. However, she had trouble getting the spoon to her mouth without spilling or tipping it over due to an involuntary reaction that causes her head to turn away when she brings her hand to her mouth. The new device helps the client to scoop her food from her plate. Upon release of the spoon, the device lifts and turns the spoon toward her. The spoon orients itself, allowing her to bring her mouth to the spoon to eat.

SUMMARY OF IMPACT
The occupational therapist was pleased with the result. The device addresses the client’s tendency to turn her head away when trying to eat. It also guides her scooping. Spilling and inaccuracy associated with bringing the spoon to her mouth was eliminated.

TECHNICAL DESCRIPTION
The device is lightweight, weighing 5 pounds, and is durable. The device is portable and suitable for use in any setting where a tabletop or other stable surface is present. The spoon support device has three main components: an arm system (with clamp for attachment to a tabletop), a turning mechanism, and a raising mechanism.

The arm system is part of an architect’s drafting lamp, which was slightly modified by strengthening the springs to provide stability and by removing components that restricted its range of motion. One important parameter that was optimized was the spring constant of the springs in the arm system. This optimization was done by trial and error during proof tests with the client.

The turning system includes a spiral spring obtained from a retractable tape measure and damping elements. All of these are enclosed in a PVC casing. This turning system, screwed onto the arm system at the floating end, contains a PVC spoon attachment piece at its base.

The spoon fits into the attachment piece and is fastened in place using Velcro straps to allow for easy removal. The raising mechanism relies on springs that are loaded when the client grips the spoon and pulls it down toward the plate to scoop. The spoon is removable and dishwasher safe.

Neoprene arm covers were added to prevent finger pinching by the arm system. The covers are removable and washable.

The final cost of the feeding device was $60.
Fig. 12.7. Deeding Device (Without Safety Covers).
INTRODUCTION
A client with cerebral palsy attempts to draw pictures, letters, and numbers with crayons or pencils using a tilted paper holder, but has difficulty controlling her hand and arm movement. The client is right-handed. Her left arm is subject to frequent, sporadic, and powerful extensions that interfere with most tasks. She has a firm grasp in her right hand and presses down powerfully on the paper when she draws. Therefore, she tends to break pencils and crayons. Her most successful drawings are produced when an assistant guides her hand. The client requested a means to express herself independently on paper. The pantograph table reduces many of the client’s previous difficulties. It provides a stable surface and has a large handle for ease of grasp and control. It resists force overload. The crayon or pencil is held in place and cannot fall. Various wooden guides allow the client to trace a given shape and produce a repeatable result.

SUMMARY OF IMPACT
The device allows the client to grasp and use her writing utensils without the help of an assistant. She can now write or draw without dropping or breaking her writing utensils. The guides allow her to draw or color shapes (e.g., circle, square, heart, flower) without the help of an assistant. The device reduces the extraneous motions that interfere with most of her tasks and permit the use of large motions to draw small figures. Her teacher is pleased that she can now draw almost independently.

TECHNICAL DESCRIPTION
The solution (see Fig. 12.9) is a modified pantograph attached to a freely moving joint at the top of a wooden board. A pantograph is an instrument for copying on a predetermined scale, and consists of light, rigid wooden bars joined with pins. The pantograph permits the client to draw by grasping a softball, which is mounted on a dowel at the end of the pantograph. A pantograph frame is attached to a 3” dowel rod at one end, a utensil holder in the middle joint, and a wooden cube on the other end. The drawing utensil is contained in a separate spring-loaded barrel at the middle joint of the pantograph, away from the client’s grasping point, to produce a constant pressure on the paper. When the client draws, the pantograph scales down her drawings by one half.

The wooden cube fits neatly into a stationary stand that is attached to the lip of the 2’ x 2.5’ drawing board. The lip is attached to the perimeter of the drawing board and is 1” x 2”. The wooden cube has a rotating joint, allowing the pantograph to move in all directions.

The board sits on a desk at an incline, making it possible for her to see from her chair without having to bend over the table. A Velcro strap attached to the board and around her desk prevents movement by the board during drawing. Rails on the sides and top of the board keep operations within the board area.

The major parts of this project were made of wood. The device was sanded, painted, and covered with several layers of polyurethane. Dangerous edges were rounded so that injury would not result. Drawing guides were created out of four 3” x 3” squares of 3/8” plywood. These guides were a circle, a square, a heart, and a flower. They fit onto the board with peg feet that insert into predrilled holes in the board.

The final cost for this project was approximately $90.
Fig. 12.8. Drawing Table/Pantograph Being Used by Client.

Fig. 12.9: Pantograph Drawing Aid Viewed as Schematically.
INTRODUCTION
An Emergency Call Device (ECD) was designed to enable a person with a disability to contact someone in an emergency. It is a stand-alone communicator that will work when power, land phone lines, and cellular phones are not operable. The device consists of a control unit, a transmitter, a battery back-up, and an antenna. It device can be activated to transmit a pre-determined emergency message programmed at the time of installation and customized for each user. A potential rescuer would need only a standard AM portable or car radio to pick up the signal.

SUMMARY OF IMPACT
The ECD has the potential to impact the lives of numerous persons. There is no product currently available that enables calling for help when the power and telephones are not working. Any person with an AM radio can receive the signal.

TECHNICAL DESCRIPTION
The ECD was built primarily of parts that are readily available. The human interface device constitutes the principal workings of the ECD. The primary micro-controller was built using a Javelin stamp module. This allowed control of all the device's systems using the Java programming language. Additionally, the ECD is composed of two text-to-speech cards, which convert pre-programmed text into audio output. Direct recording of voice is also possible. One card is used to deliver the emergency message via AM transmission. The other card is used to provide audio feedback to the user.

The operation of the device is achieved in two ways. The buttons on the front of the ECD can operate the system allowing the user the ability to see via LCD the mode and operation of the ECD. The same operation can be achieved through use of an included hand-held remote. The remote transmits to the interface device and allows the user to activate the system from anywhere in the home. The main interface device is hardwired to the AM transmitter and the transmitter is wired to the antenna. The AM transmitter has a transmission range of up to 2 miles. The battery provides up to 72 hours of operation and can be placed anywhere in the home.

The following features were included in the design:
Processing: A principal component is the Javelin® stamp (Parallax stock # JS1-IC). This microprocessor is the brains of the device and is programmed in Java. To mount the micro-processor and provide power control as well as a serial port for programming the chip, a carrier board was installed (Parallax #27130). This provided the basis for which all other components were attached.

Interface: The design of the ECD was made using a 20 character by 2-line LCD display (Parallax #30057). The device is small enough to conserve space, and big enough to give the user adequate feedback (see Fig. 12.11). In addition to the LCD, three LEDs were selected: blue, red, and green. The blue LED was selected to be the indicator of normal operation to let the user know the device is on. The red LED was chosen to indicate that something is wrong or that the system is being turned off. The green LED was chosen to show that the system was being activated or is transmitting. The user’s manual contains complete description of what each light color and pattern indicates. Included in the interface are an on/off switch, speaker, text-to-speech card and wireless remote. The switch controls the main power for the system. It glows red when the system is receiving power. The speaker gives feedback as to the status of the system and provides audio instructions and warnings to the user. A text-to-speech card in the interface device (Parallax #30006) provides an audible output. The card converts text sent to it from the Javelin stamp microprocessor and converts it to a voice output.

Activation: There are two ways in which the device can be activated or deactivated. First, it can be activated by the interface. There are three buttons: Activate, Deactivate, and Mute. The wireless remote included with the receiver in the interface device (Parallax #28005, #28004) transmits at 418 MHz and should provide a range of activation larger than most homes. Although the remote has a total of five buttons, only three are used. The buttons that are used correspond to activate, deactivate, and mute as on the interface device. Transmission is carried out in a way similar to the speaker output. The programmed emergency message is sent to a text-to-speech card where it is converted to a voice signal. That signal is then sent to the transmitter. A low-power FM transmitter for demonstration was used. An AM transmitter capable of transmitting at least 2 miles was determined to be the best option for use. This will be connected to the interface device through the use of coaxial cable via port on the side of the interface device.

The cost for parts to build this system and battery back-up was $640.
INTRODUCTION
The Emergency Locating System was designed to permit individuals with disabilities to call for help during a natural disaster when other forms of communication are inoperable. With the device, the clients will have the ability to contact the proper authorities and alert them of their location along with other important and vital information. The product represents an adaptation of the technology used by available EPIRBs (Emergency Positioning Indicating Radio Beacon). The device will mount onto the client’s wheelchair. In an emergency, he or she will activate the system. The EPIRB sends a signal to Coast Guard monitored satellites and forwards the signal to the proper headquarters. Once the headquarters have received the signal, they will contact the local rescue authorities, who will execute the necessary rescue mission. The system uses a GPS (Global Positioning Satellite) with 250 feet accuracy and a response time within 5 minutes.

SUMMARY OF IMPACT
Emergency preparedness has become a more prevalent issue in the United States because of events involving terrorism, natural disasters, and possibly personal health-related issues. For example, during Hurricane Katrina several people lost their lives or are still missing as a result of their inability to call for help because cell phones and landline phones were down. Had emergency personnel been able to locate these individuals, several lives may have been saved. The elderly and persons with disabilities were at particular risk. For example, approximately 40% of the individuals that died as a result of Hurricane Katrina were over the age 71 (disabilities not specified). Further, the scope of this problem is easily appreciated with the statistic that of the 44,000 persons with disabilities in Orleans Parish, approximately 19,000 are over 65 years of age. For New Orleans and many other areas, the threat of natural and manmade disasters continues. Therefore, the large-scale need exists for a service that will permit people to be located and helped when all other established communicative options have failed. With the Emergency Locating System, persons with disabilities will have the means to be identified and located.

TECHNICAL DESCRIPTION
The product uses the EPIRB system. This system is currently in operation to provide distress calls and location assistance for ships and other watercraft. The product’s components include a GPS receiver, an antenna, a transmitter, and a battery. GPS is a satellite navigation system that broadcasts precise timing signals by radio to GPS receivers, which allow them to accurately determine their location.

The device can be activated manually or automatically to transmit emergency locating signals to proper rescue authorities. Satellites detect the signals from the 5-watt radio transmitter operating at 406 MHz. The accuracy of location is within 250 feet and the activation delay time is about 5 minutes.

Included in the signal is a serial number as well as the unit’s location (determined by GPS). Pre-registration is required. The serial number permits linking the call to personal information (e.g. owner’s name, address, phone number(s), disability(s), and any other facts. This data permits the responders to develop the most efficient rescue plan. Non-marine use is not yet approved, but must be before this system can be made available for general use.

The cost of this device is under $1000.
Fig. 12.12. Emergency Locating System based on a modified Emergency Positioning Indicating Radio Beacon (EPIRB).
INTRODUCTION
The client, a high school student, has osteogenesis imperfecta (OI). OI, a brittle bone disease, is a genetic disease characterized by bones that fracture easily. The genetic defect affects the body's normal production of collagen. In particular, bone growth and strength are greatly reduced.

For transport, she rides in her family's minivan. She is most comfortable lying flat due to scoliosis of her spine and limited ability to raise her head. She lies on a pad or blanket on the van floor behind the driver's seat. Due to her bone strength and body size, the client is unable to use a normal restraint system such as seatbelts, a child restraint seat, or car beds. Not only is this method unsafe, but the client is also not able to see outside the van.

The team designed a van transport system to allow for her safe transport while also allowing her to look...
out the window.

**SUMMARY OF IMPACT**

This system will allow the client to ride in her family’s van and see out the window. It will keep her safe and comfortable and provide her with a much improved transportation experience.

**TECHNICAL DESCRIPTION**

The van transport system consists of three main components. The first component is the PVC frame. The pipe segments have a nominal inside diameter of one half inch and are connected with standard and custom joints. There are two ninety-degree, two cross, two five-way, thirty-six tees, eight three-way corners, and four four-way corner connectors. The PVC frame is joined to the existing car seat frame with four two-and-a-half inch long 3/16” machine screws.

The second component is the reinforcement, which consists of a 1/8” inch diameter steel wire rope. The rope was galvanized and has ultimate tensile strength of 1,700 lbs. The wire rope is joined using standard 1/8” inch crimps. The wire rope runs through the two highest rectangle structures of the PVC frame as well as the ten vertical sections that connect the two rectangles. There are eight safety wires that exit the lower rectangular PVC section and secure to the car seat frame by forming a loop and being crimped. Sections of the PVC pipe are removed from the frame to allow the exit of the safety wires; these are covered with PVC patches connected to the frame using hose clamps. Two hose clamps are used for each patch.

The final component of the design is the mattress and the net. The mattress is a four-pound rated Tempur-pedic® pad. Standard cargo netting covers the pad. The cargo netting is held into place in sixteen locations. Two adjoining sides are attached at 8 places to the PVC frame. The remaining eight connections are made using 2” carabineers. The net is held free of the client by a line that extends from the roof of the mini-van.

In a crash event, the system will absorb energy through the frangible PVC frame. It also spreads deceleration force. This restraint system is designed to protect the client in the event of a front, rear, or side collision as well as a rollover event.

The total estimated cost of the transport system was $460.