1. Research the topic of prosthetics and report on major developments in its history.

2. Give several examples of the ways that orthotic devices have improved over the years.

3. Describe some of the ways technology can be used in designing prosthetics.

4. Compare and contrast the uses of orthotics vs. prosthetics.

CRITICAL THINKING EXERCISES

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BACKGROUND

In the event that a person loses a limb to disease or injury, or if they were born without one, orthotics and prosthetics can be invaluable. The loss of a hand or an arm can alter how a job is performed and how one goes about daily tasks. The loss of a foot or leg has obvious implications regarding walking and running. Designing and creating prosthetic devices is highly personalized because it directly affects a person’s life. Despite that prosthetic devices are not quite capable of the same tasks as a patient’s original biological limbs, today’s scientists and engineers strive to mimic the anatomy and physiology of missing limbs to give patients a realistic experience. They hope to get as close to the real thing as possible because people often struggle with emotional aspects of losing limbs as well as the physical absence.

Organizations such as Hanger Incorporated create ground-breaking prosthetic innovations with the help of microprocessors, carbon fiber, accelerometers, robotics, and advanced socket materials. As one of the largest rehabilitative product and service organizations in the world, Hanger makes high end products such as the bebionic hand, which utilizes individual actuators to drive each finger. Each digit moves and grips in a natural and coordinated manner, providing compliant and conformable grips around complex shapes. Hanger has also developed the élan microprocessor-controlled hydraulic foot. Using patented microprocessor-controlled technology, the foot provides real time, simultaneous adjustments as the user walks, allowing for smoother gait.

ADVANCED ORGANIZERS

Prior to viewing the video students should have some understanding of the following Science Benchmarks from AAAS, Project 2061. This is a longterm initiative focused on improving science education so that all Americans can become literate in science, mathematics, and technology.

Benchmark 3. The Nature of Technology.
Section B. Design and Systems, Grades 3-5

By the end of the 5th grade, students should know that

- There is no perfect design. Designs that are best in one respect (safety or ease of use, for example) may be inferior in other ways (cost or appearance). Usually some features must be sacrificed to get others. 3B/E1

SUGGESTED REFERENCES

- AAAS, Project 2061: http://www.aas.org/program/project2061
- American Academy of Orthotists and Prosthetists: http://www.oandp.org/
- Orthotics and prosthetics Career information: http://www.opcareers.org/
- Hanger homepage: http://www.hanger.com
- The International Society for Prosthetics and Orthotics: http://www.ispoint.org/
- History of Prosthetics and Orthodics: http://www.ap.gatech.edu/mspo/old/about.htm
- Prosthetics with Mind Control: http://science.howstuffworks.com/prosthetic-limb4.htm
In this activity, students work in teams to design and build a working robotic arm from a set of everyday items. Each arm should be able to pick up a Styrofoam cup. Participating teams of three or four students are provided with a bag including the materials listed below. Each team must use the materials to design and build a working robot arm. The robot arm must be at least 18 inches in length and be able to pick up an empty Styrofoam cup. Teams of students must agree on a design for the robot arm and identify what materials will be used. Students will draw a sketch of their agreed upon design prior to construction. Resulting robot arms are then tested to pick up the cup.

**Materials:** hole punch, 2 large paper clips, marker, 1 medium brass fastener (1 in. [2.5 cm]), paper cup, smooth string (39 in. [100 cm]) (for example, fishing line), 1 straw (cut into 1-in. [2.5-cm] lengths), 1 strip of corrugated cardboard (about 2 x 4 in. [5 x 10 cm]) (corrugated cardboard has grooves in the middle, like a cardboard shipping box), 1 strip of corrugated cardboard (about 2 x 8 in. [5 x 20 cm]), tape

**Procedure:** The goal of this activity is to design and build a robotic arm that can pick-up a Styrofoam cup. Explain that teamwork, trial, and error are part of the design process. There is no “right” answer to the problem – each team’s creativity will likely generate an arm that is unique from the others designed in your class.

1. Divide your class into teams of about four students.
2. They are then instructed to examine the materials and to work as a team to design and build a robot arm.
3. The robot arm must be at least 18 inches in length and be able to pick up an empty Styrofoam cup.
4. Teams of students must agree on a design for the robot arm and identify what materials will be used.
5. Students draw a sketch of their design before construction.
6. When finished, the teams of students can test their robotic arms to see if the Styrofoam cup can be lifted.
7. If time permits, robotic arms can be tested to see if they can pick-up a cup loaded with different amounts of giant paper clips.