PROSTHETIC LIMB

An Engineering Feat

Prosthetics are mechanical devices that replace human limbs lost through accident, illness, or congenital conditions. Biomedical engineering is the integration of biology, medicine and engineering. Biomedical engineers have developed a number of life-enhancing and life-saving technologies such as—prosthetics, surgical devices (robotics and laser surgery), and systems to monitor vital signs and blood chemistry.

In everyday life, many people require replacement body parts. Those who need an artificial leg must have a structurally stable one to replace a critical part of their skeletal system. One aspect of biomedical engineering is designing and researching new and better prostheses (replacement body parts). Biomedical engineers are continually improving the strength, durability, longevity and lifelikeness so amputees can lead full lives.

Teams of four students will investigate the technology of prosthetics. The teams will design a model prosthetic lower leg using various materials. Each team should demonstrate its prosthesis' strength and consider its pros and cons, giving insight into the characteristics and materials biomedical engineers consider in designing artificial limbs.

MATERIALS NEEDED FOR EACH TEAM

- A yardstick, ruler, or tape measure
- Scissors
- One type of prosthetic structural material with which to create a prototype (note: the number of groups depends on how many different prosthetic resource materials are collected)

  Suggestions:
  - For leg structure: toilet plungers (unused), plastic pipes,metal pipes, metal strips, cardboard tube (from wrapping paper roll), wooden "2 x 4," thin metal duct material (to be rolled and taped into a tube shape), all generally 1.5 ft (or .46 m) long
  - For comfort: Large sponges, scrap bubble wrap, scrap cardboard, etc.
  - For lifelikeness: bath towels, pairs of pants, shoes (use students')
  - For body attachment: String, rope, twine (about 30 ft [or 10 m]).
  - 1 roll duct tape

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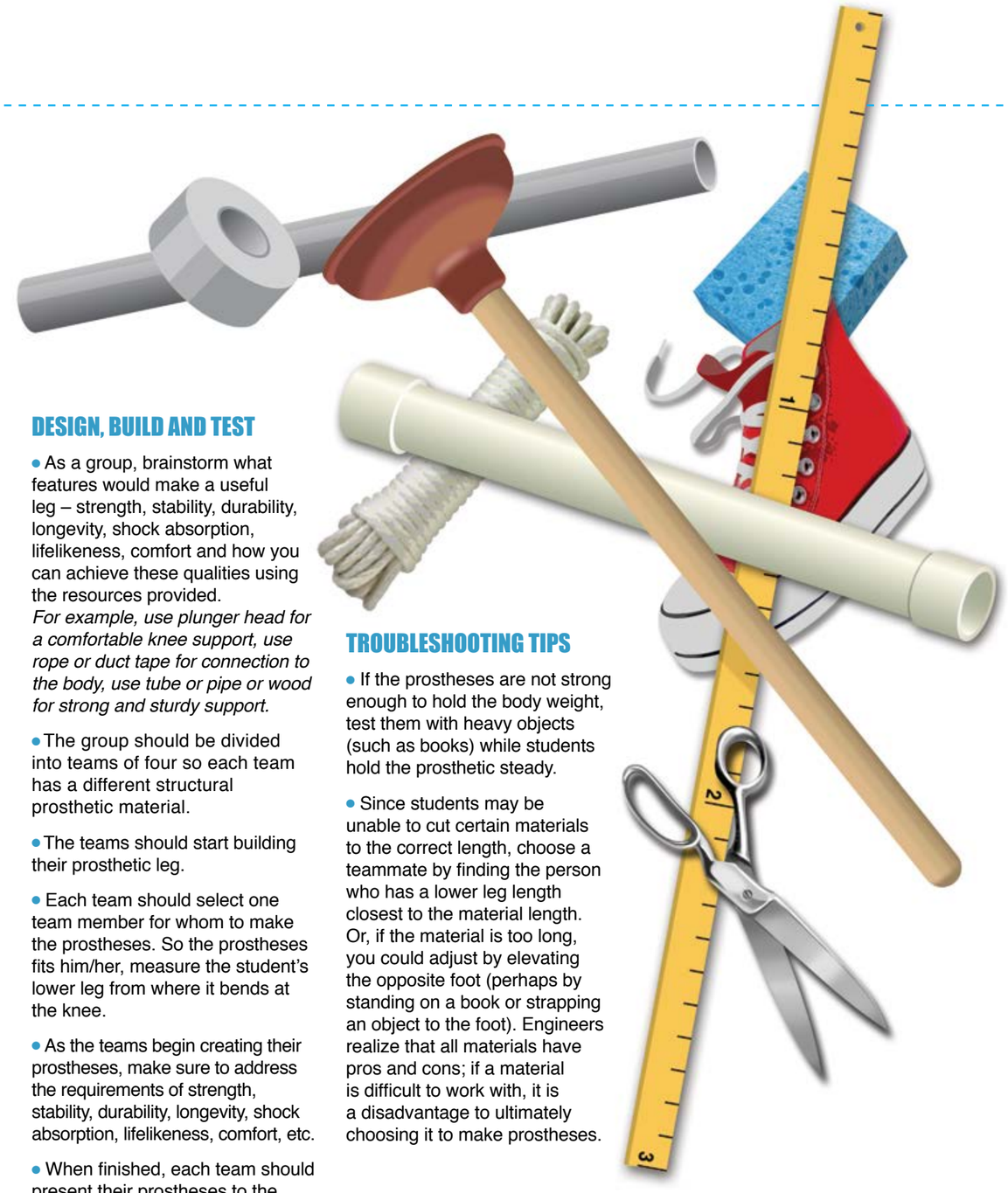

DESIGN, BUILD AND TEST

- As a group, brainstorm what features would make a useful leg – strength, stability, durability, longevity, shock absorption, lifelikeness, comfort and how you can achieve these qualities using the resources provided.
  For example, use plunger head for a comfortable knee support, use rope or duct tape for connection to the body, use tube or pipe or wood for strong and sturdy support.
- The group should be divided into teams of four so each team has a different structural prosthetic material.
- The teams should start building their prosthetic leg.
- Each team should select one team member for whom to make the prostheses. So the prostheses fits him/her, measure the student's lower leg from where it bends at the knee.
- As the teams begin creating their prostheses, make sure to address the requirements of strength, stability, durability, longevity, shock absorption, lifelikeness, comfort, etc.
- When finished, each team should present their prostheses to the group and explain the design concepts and choice of materials. Teams should have "spotters" positioned around the person testing in case he/she falls.

TROUBLESHOOTING TIPS

- If the prostheses are not strong enough to hold the body weight, test them with heavy objects (such as books) while students hold the prosthetic steady.
- Since students may be unable to cut certain materials to the correct length, choose a teammate by finding the person who has a lower leg length closest to the material length. Or, if the material is too long, you could adjust by elevating the opposite foot (perhaps by standing on a book or strapping an object to the foot). Engineers realize that all materials have pros and cons; if a material is difficult to work with, it is a disadvantage to ultimately choosing it to make prostheses.

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