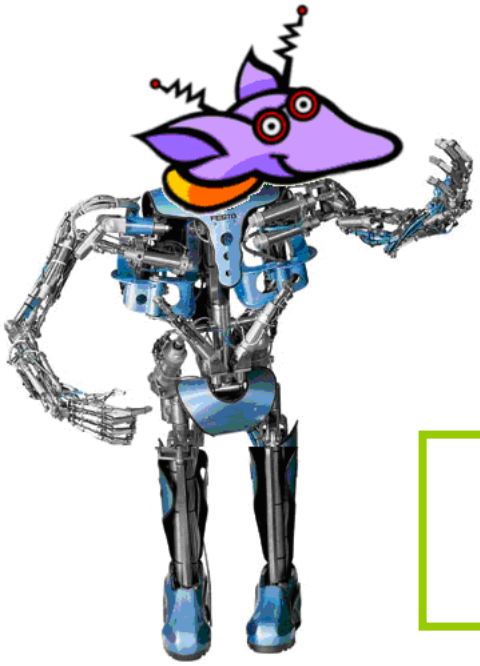


BIONIC KIDS

WEEK 2: LEVERS

EVER WONDER . . . HOW LEVERS CAN GIVE YOU SUPERHUMAN STRENGTH?

What we learned this week:

- What a lever is and how it can make lifting and throwing things easier.
- How our bones and muscles make biological levers.
- What a catapult is and how it can hurl heavy things long distances.

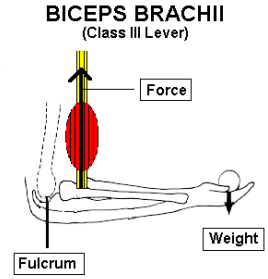
Today's Experiments

1. Lift heavy objects using a lever and fulcrum.
2. Experiment with a can crusher.
3. Make a robot finger.
4. Experiment with catapults.

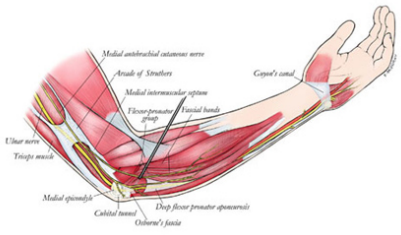
Did You Know?

- A lever is a simple machine composed of a fulcrum and a bar. The fulcrum is the point at which the bar moves. There are two important forces operating on a lever: the effort and the load. The effort pushes or pulls the lever to make it move. Examples of effort include pulling up on the handles of a wheelbarrow to lift a heavy load or pulling up on the handle of a hammer to pry up a nail. The load is the weight of the thing that the lever is trying to move. Examples of loads are the gravel in the bed of a wheelbarrow and the nail being pried up by the hammer.

- To lift or move something, the force of the effort must be greater than the force of the load. A lever helps to overcome the force of the load by multiplying the force of the effort. The longer the lever, the more the effort is multiplied. Thus, levers allow you to lift things more easily, throw things farther than you could otherwise, etc. Some examples of levers are lacrosse sticks, hammers, scissors, nutcrackers and staplers. Levers aren't just objects, however. You have levers in your own body! Your body's levers are made up of bones (the "bar"), joints (the "fulcrum") and muscles (which provide the "effort").



- Bones are the hard parts of your body that serve as structure and support. Bones also provide protection for your internal organs. There are even bones in your ear that help you to hear! Bones are made up of minerals such as calcium and phosphorus and sometimes have blood vessels inside them (as is the case with one of the bones in our legs). An adult human has about 206 bones. Bones act as the bar in your body's levers.



- Bones are connected to each other by tough, stretchy ligaments. The place where two bones meet and move is called a joint. This joint is the fulcrum – the place where the "bar" (bone) moves. Though your bones are hard and very difficult to bend without breaking, joints allow your body to bend and move. (Can you imagine if your body was one giant bone that couldn't bend or move?) For example, knuckle joints allow your fingers to bend; elbow joints allow your arms to bend; knee joints allow your legs to bend.

- But what causes your bones to move? Bones are moved by muscles. Muscles are a type of tissue in the body that can expand and contract like rubber bands; they push and pull your bones up and down, side to side, etc. Muscles are connected to bones by tough bands of tissue called tendons. This system of bones and muscles is called your musculoskeletal system.
- The biological levers in your musculoskeletal system include your arms, legs, jaw, feet and fingers. For example, when you throw a tennis ball, your arm is working as a lever. Your arm bone is the bar, your elbow is the fulcrum, the tennis ball is the load, and the effort is the force provided by your muscles. How can you make your "lever" work better? The stronger the muscle, the greater the force, and the better your lever will work! Also, the longer your arm is, the more the effort of your muscle will be multiplied. This is why adults can usually throw farther than kids can (bigger muscles x longer bones = lots more force). Because you can't really grow your arm bone at will, working on your muscles is probably your best bet for throwing a tennis ball farther!
- Though your arm will likely never be strong enough to hurl a car through the air, a big enough catapult could! Catapults can be designed to hurl extremely heavy objects through the air. They were likely invented by the ancient Greeks, and were used extensively during the middle ages to hurl giant boulders at castles and fortresses. Today, catapults are still used for all kinds of things. There is even an annual design contest to see which catapult can hurl a pumpkin the farthest. In 2005 the winning catapult hurled a pumpkin 2066 ft! The same catapult could also throw a 120 pound clothes dryer and a 200 pound riding mower!

Science in Your World

Because scientists understand how biological levers work, they have been able to create the world's first bionic arm! The arm now belongs to a man named Jesse Sullivan. In 2001, he was working on a power line when he had an accident and lost both arms. Before he received his new bionic arm, he had surgery to move four of the nerves that control his arm and hand movements; the nerves were reconnected to the muscles in his chest. When the bionic arm was attached, it was able to read the electrical impulses sent from the brain through those nerves. When Mr. Sullivan thinks about closing his hand, the nerve that would normally send the signal to muscles in his hand now sends the signal to a specific muscle in his chest. When that chest muscle contracts, sensors in the bionic arm are triggered and the hand closes! Just by thinking about closing his hand or moving his arm, his bionic arm will respond. This allows Mr. Sullivan to mow the lawn, put on socks and even use silverware!

Curiosity @ Home

Make a robot hand. Materials: string, card stock or poster board. Procedure: Make 4 other fingers just like the one that you made in class today by downloading the finger pattern at http://www.sciencetoymaker.org/robotFinger/assembl.html. Once you have your 5 fingers made, attach them to a square piece of poster board to make a hand that can move!

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