STEM PEDAGOGY: THE CONCEPT OF SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS APPLIED IN TEACHING HUMAN BIOLOGY

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Abstract

Science teachers have been finding it difficult to truly apply the concept of integrating science, technology, engineering and mathematics when teaching the individual disciplines for which they have been certified. Students have not been able to see the unity that exists in STEM. This poster uses a human arm to demonstrate how teaching science can vividly expose the concepts of mathematics, engineering and technology. This demonstrates an inspired and motivated unit on teaching human biology which leads to understanding the relationship of science, technology, engineering, and mathematical concepts.

Objectives

By the end of this unit students will be able to:

- Identify the bones and joints in the arm and describe how the muscular and nervous systems aid in movement. (science)
- Measure and graph angles of arm, wrist and finger movement. (math)
- Explain how prosthetic arms work. (engineering)
- Program a robotic arm to move. (technology)

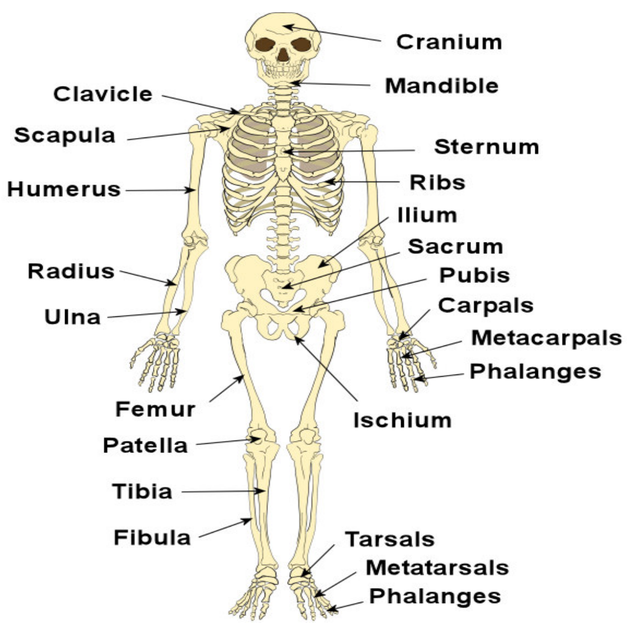
Science

Main points to learn about the Skeletal System

Made up of bones, cartilage, and connective tissue
Human skeleton has 206 bones
Cartilage: flexible tissue in nose and ears
Connective tissues are tendons and ligaments

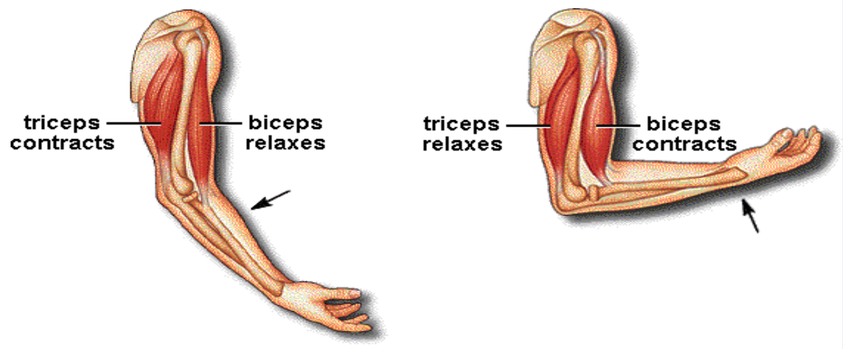
Three types of joints

Gliding joint: bones glide over each other like *hand and wrist*
Ball-and-socket joint: moves in all directions like *shoulder*
Hinge joint: flexes and extends, moves like a door, like an *elbow*



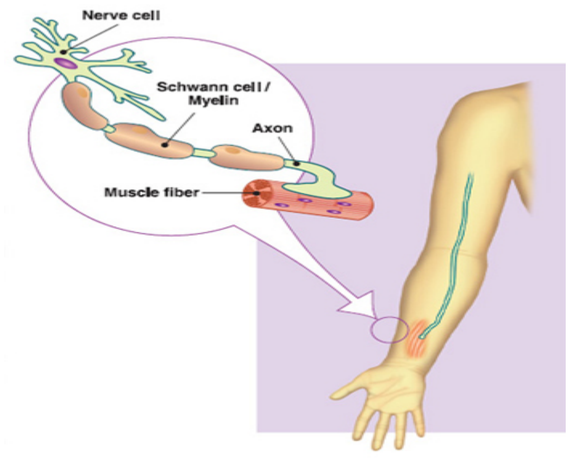
Muscular System

- Skeletal muscles help bones move
- Voluntary movement: a muscle moves when nervous system tells it to
- Muscles are attached to the bone by tendons
- Biceps and triceps control the arm - antagonistic
  - Biceps muscle flexes and bends the arm
  - Triceps muscle extends and straightens the arm



Nervous system

- Neurons send electrical signals called impulses
- Controlled by central nervous system (spinal cord and the brain)
- Axon connected to muscle fibers to make muscles contract

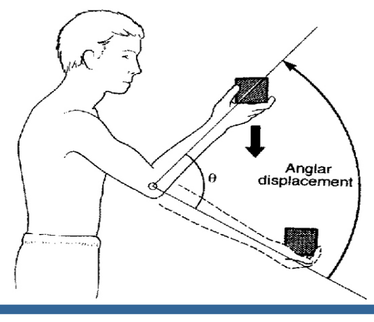


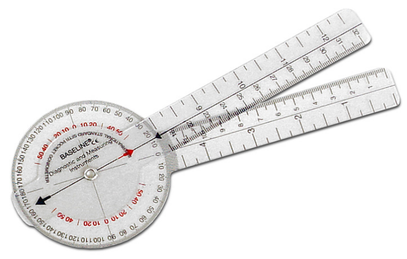
Design and create a moveable elbow joint out of household items

Mathematics

Geometry : Angles

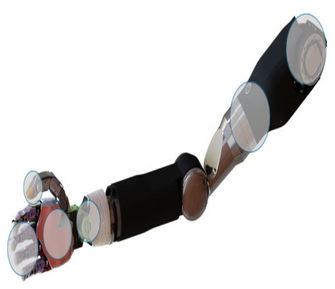
- Measure angular arm movement with a goniometer



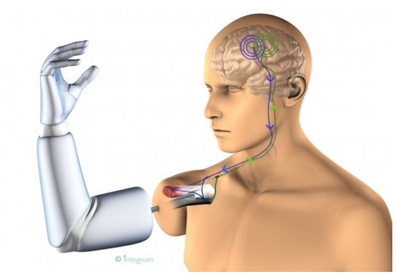


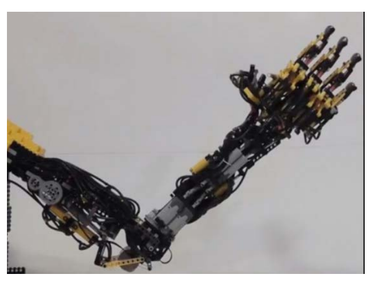
Engineering

- Old prosthetics worked by attaching a "forearm" with a hook at the end the shoulder with a strap.
- Lower arm and hook "hand" were controlled by moving the shoulder



- Dynamic prostheses use electronics to move
- Sensors detect muscle electricity and transmits the signal to the artificial hand, powered by batteries
- Engineers are working on prosthetic arms that are controlled by the brain
- Prosthetic receives electrical activity from the brain through the nerves not just the muscle movement
- Make moveable arm and hand out of Lego's





Technology

Robot Arms Used in Manufacturing

- Robot arms were created to perform jobs that are dangerous and potentially deadly for humans
  - Electric motor
  - Air muscles (expand and contract with air)
  - Actuators (store energy)
  - Wires (send electric signals)
  - Sensors
    - "see" with infra-red light sensors
    - "feel" with fluid fill ridges that compress
  - Programmed by computer

Conclusion

- Science has been stereotyped as difficult. One of the key reasons is the fact that students do not see the value of learning science. Also, the method of teaching some science disciplines tends to be boring and less interesting and less engaging. This demonstration unit about the human arm is attractive, hands-on and engaging. Students would be motivated and encouraged to learn science more when they see clearly the end results of the science content knowledge they acquire. Understanding the science of the human arm(anatomy and physiology) and how engineers have used the knowledge of mathematics (measurement and graphing) and various forms of technology (robotic arms) created to perform jobs that are dangerous and potentially deadly for humans and prostheses designed to replace disabled limbs which can improve and protect the affected body parts. These are values of teaching STEM and therefore it is important to note that the teaching of science integrating technology, engineering and mathematics concepts would give graduates the skills they need to excel in the field of research and future careers.

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