SCIENCE SPECTRUM

MAGAZINE

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MAGAZINE

BIONICS

VOLUME NO. 2 • NOV

Prosthetics

The Future of Prosthetics

Abstract:
An estimated 1.6 million Americans were living with limb loss in 2005, with a projected increase to 3.6 million by 2050[1]. This is representative for the need of better technologies facilitating the lives of those suffering from limb loss. Bionics is a growing field that needs all the recognition for its great research in the field.

Bionics is defined as the “science of constructing artificial systems that have some of the characteristics of living systems” [2]. Creating these systems to perform functions similar to biological limbs is a great challenge for bionics. This will help a large group of people, suffering from amputations or birth defects, to go through life in a comfortable and easy way.

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Introduction:

Prosthetics is another sub-field with different elements. The general definition is: “prosthesis, artificial substitute for a missing part of the body” [3]. This could means that any alternative for any organ with a specific task not being done correctly is considered as a prosthetic. This article however will focus on prosthetic limbs, looking at their advancements through recent years, and prospects for this existing technology. How the handicapped benefit from this, and how electrical transmissions could be used for movement with the help of artificial limbs is also a central focus.

People who are disabled are going to be a focus throughout, so it will also be important to know exactly what is meant by someone who is disabled. The National Health Service (NHS) defines this term as “someone who has a physical or mental impairment that has a substantial and long-term negative effect on their ability to do normal daily activities” [4]. The mechanisms used in these complex machines are created by complex minds that focus on permanent and long-term issues in people, by improving their lives. Running Blades and Myoelectric arms for example are some of the more fascinating prosthetics, definitely displaying the mechanical abilities of bionics.

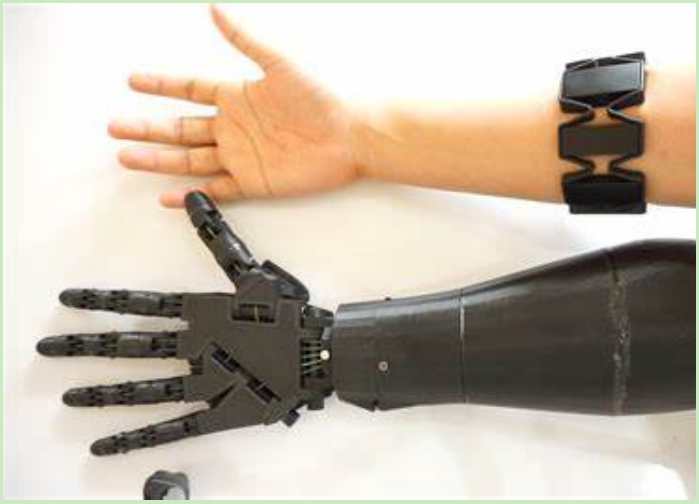
Prosthetic Legs (Running Blades):

The most common use of prosthetics is in tournaments as in the world-renowned Paralympics. Pictures of racers, suffering from bilateral trans-tibial amputation or birth defects are often seen with prosthetic legs, or more specifically running blades functioning as legs and requiring more control. Even though these particular prosthetics do not have anything to do with conscious control, they replicate the biological leg when used for walking, running and of course, sprint racing and swim racing. Certainly, nothing will be a perfect replicate of the complex biological limbs and organs, but these prosthetics will provide. By prosthetic legs in this case, what is meant is a running-specific prostheses (RSF). The Royal Society Journal has described the RSF as a replicate of the spring-like nature of the biological legs (bioL) during running [5]. With prosthetic legs the biological process of running, becomes more like a bouncing movement. So, springs in these artificial legs should be ideal for running. There are multiple studies are done related to how vertical stiffness would be converted into mechanical energy and movements. Specific values are calculated and encountered to designand cater the specific athletes. Knowing that running is a bouncing motion, the running blade is able to produce this mechanical movement since it is made up of stiff metal frame with a flat spring like surface in contact with the ground. This flat surface also has sharp protrusions to increase grip with the ground like the football shoes. Sprint racing with these legs is not an easy task. It takes a while to adapt, train and maintain control, and these paralyzed athletes should be seen in the same light as other athletes. It is also important to note that running blades are different from muscle-controlled limbs therefore, the adaptation part would be an important challenge for them.

Prosthetic arms (Myoelectric prosthesis):

One of the recent advancements in prosthetic development has been the use of muscles and electric signals. Myoelectric refers to the electric properties of muscles [6]. With even more advancements in this area like the ability to feel, engineers and medical professionals are giving amputees a way of living that is as close to normal as possible. There is no better source of information than one completely dedicated to the subject which is 'Arm Dynamics'.
They provide a lot of information about these myoelectric arms [7]. The arm itself is controlled by motors that respond to electric signals created by muscles. These signals are produced by normal contractions in upper arm area (Stump) and as the body sends these 'messages' to the electrodes, they will respond accordingly. The electrodes located on the skin inside the socket will detect these muscle signals and send them to a controller.

Then, using these signals, specific parts only will perform functions that would otherwise be performed by a normal arm.



Robotic myoelectric arms such as these consist of several moving parts needed to replicate human movement and therefore cost a high price. Adjustments also have to be made every few years and these arms usually cannot last very long, although this depends heavily on level of activity and use. Most funding agencies expect at least five years of use for a prosthesis with occasional maintenance and repairs [8].

Advancements:

The world of prosthetics is not a static one. There have been several new advancements over recent years, but the most interesting one is probably the introduction of feeling mechanisms. These people will finally be able to feel and judge for themselves how hard to push, pull or grip. An example of such a prosthetic arm is the LUKE arm, named after Luke Skywalker, who lost an arm to Darth Vader in Star Wars episode 5. Originally developed in 2017, this is still receiving development [8].

An article in the Washington Post explains in detail how this sense of touch works. The electrodes talked about in basic myoelectric arms are extended to also receive signals like “sensation to be transmitted back to the subject’s nervous system”, finally ending the otherwise incomplete biological loop and removing Phantom Pain. Patients often complained about Phantom Pain because of their inability to feel yet the ability to move their prosthetic arms [9].

Conclusion:

So, as we can see, prosthetic technologies have made a huge improvement by using the laws of physics and nature to facilitate the lives of hundreds and even thousands of people. From their use in athletics and sports, allowing bilateral amputees to remain active to their use in everyday life, prosthetics will have a bright future. Unfortunately, prosthetics are still not very accessible to majority of the disabled public especially those in developing countries due to their high cost, constant maintenance requirements and continuous replacement. The World Health Organization has estimated that 30 million people are in need of prosthetic and orthotic devices, yet more than 75 percent of developing countries do not have a prosthetics and orthotics training program in place [10]. This shows that although the continuous advancements, not all suffering patients will be able to receive these prosthetics. Still, this is a fascinating showcase of science, and the engineers and medical professionals that led to these bionics should be rewarded.

References:

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Crossword

Organic Chemistry

Across

[3] hydrocarbons with similar boiling points separated from crude oil (8)

[4] easily ignited and capable of burning rapidly (9)

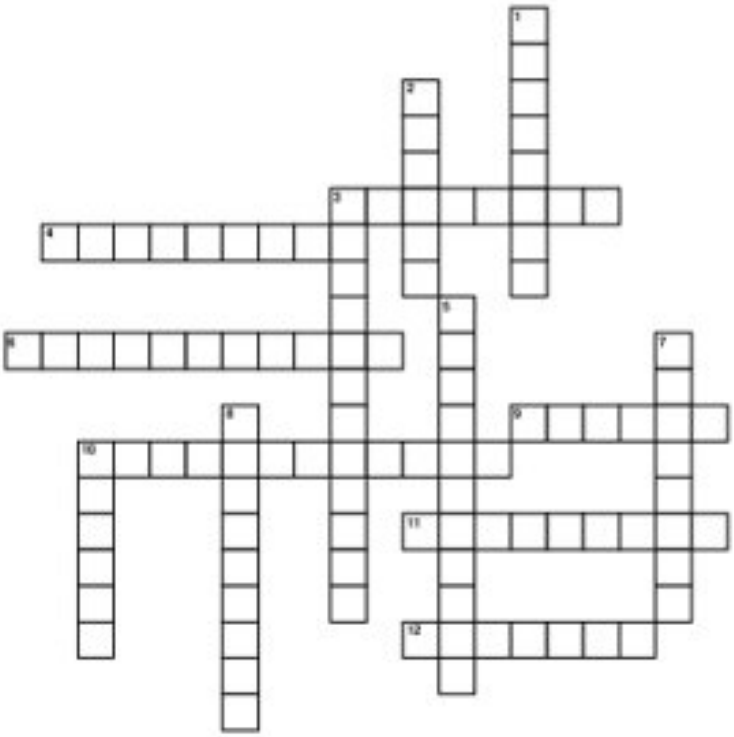
[6] a hydrocarbon whose molecules contains at least one carbon– carbon double bond (11)

[9] unsaturated hydrocarbon whose general formula is CnH2n (6)

[10] separation of a liquid from a mixture by evaporation followed by condensation (12)

[11] describes a hydrocarbon with only single bonds between its carbon atoms. (9)

[12] a substance made from very large molecules made up of many repeating units (7)



Down

[1] the reaction used in the oil industry to break down large hydrocarbons into smaller, more useful ones (8)

[2] saturated hydrocarbon the general formula CnH2n+2 (6)

[3] the reaction in which the enzymes in yeast turn glucose into ethanol and carbon dioxide (12)

[5] a compound containing only hydrogen and carbon (11)

[7] small reactive molecules that react together in repeating sequences to form a very large molecule (a polymer) (8)

[8] the resistance of a liquid to flowing or pouring; a liquid's 'thickness' (9)

[10] _____ bond is a covalent bond made by the sharing of two pairs of electrons (6,4)

ANSWERS AT THE BACK

WORD SEARCH

Life Science Word Search

I	N	T	H	O	Z	Y	G	I	I	T	I	S	S	U	E	T
P	H	O	T	O	S	Y	N	T	H	E	S	I	S	O	O	N
S	O	V	N	H	G	L	G	E	N	S	S	P	I	E	I	Y
R	E	A	E	O	H	L	P	O	O	O	S	U	S	T	G	M
L	I	C	G	M	O	Y	A	G	T	E	P	M	I	O	E	M
N	O	U	I	E	T	H	H	Y	K	E	E	H	L	I	E	I
I	T	O	T	O	M	P	C	V	N	T	C	O	M	T	H	T
S	N	L	N	S	N	O	I	T	A	R	I	P	S	E	R	O
O	E	E	A	T	G	R	S	B	L	B	E	Y	A	S	E	S
Y	G	C	E	A	U	O	O	O	P	Y	S	T	L	M	I	I
M	O	N	H	S	E	L	T	E	M	O	I	B	P	S	Y	S
C	H	P	O	I	I	H	L	I	C	O	S	M	O	S	I	S
E	T	E	R	S	E	C	N	E	M	A	R	I	T	X	O	I
A	A	I	M	A	I	R	E	T	C	A	B	H	Y	S	O	L
S	P	B	O	A	L	L	E	L	E	M	B	L	C	M	R	H
L	S	E	N	S	L	U	S	E	Y	C	E	O	L	P	A	B
I	S	U	E	L	C	U	N	S	S	M	C	T	R	L	E	S

Allele
Antigen
Bacteria
Biology
Biome
Cell
Chitin
Chlorophyll
Chromosome
Cytoplasm
Ecosystem
Genotype
Homeostasis
Hormone
Metabolism
Mitosis
Nucleus
Osmosis
Pathogen
Phagocytosis
Photosynthesis
Plankton
Respiration
Species
Symbiosis
Tissue
Vacuole
Virus
Xylem
Zygote

ANSWERS AT THE BACK

RIDDLES

1. I am a gas that is essential for plants - but I can't be bought at the gas station. What am I?

2. I am hard as a stone but you can find me on your body. What am I?

3. What is neither water nor land but is always soaking wet?

4. What has a mouth but can't chew?

5. What kind of tree can fit in your hand?

6. Which is heavier, a ton of feathers or a ton of rocks?

7. It is very hard to create me, but I can't be destroyed - I can only change form. What am I?

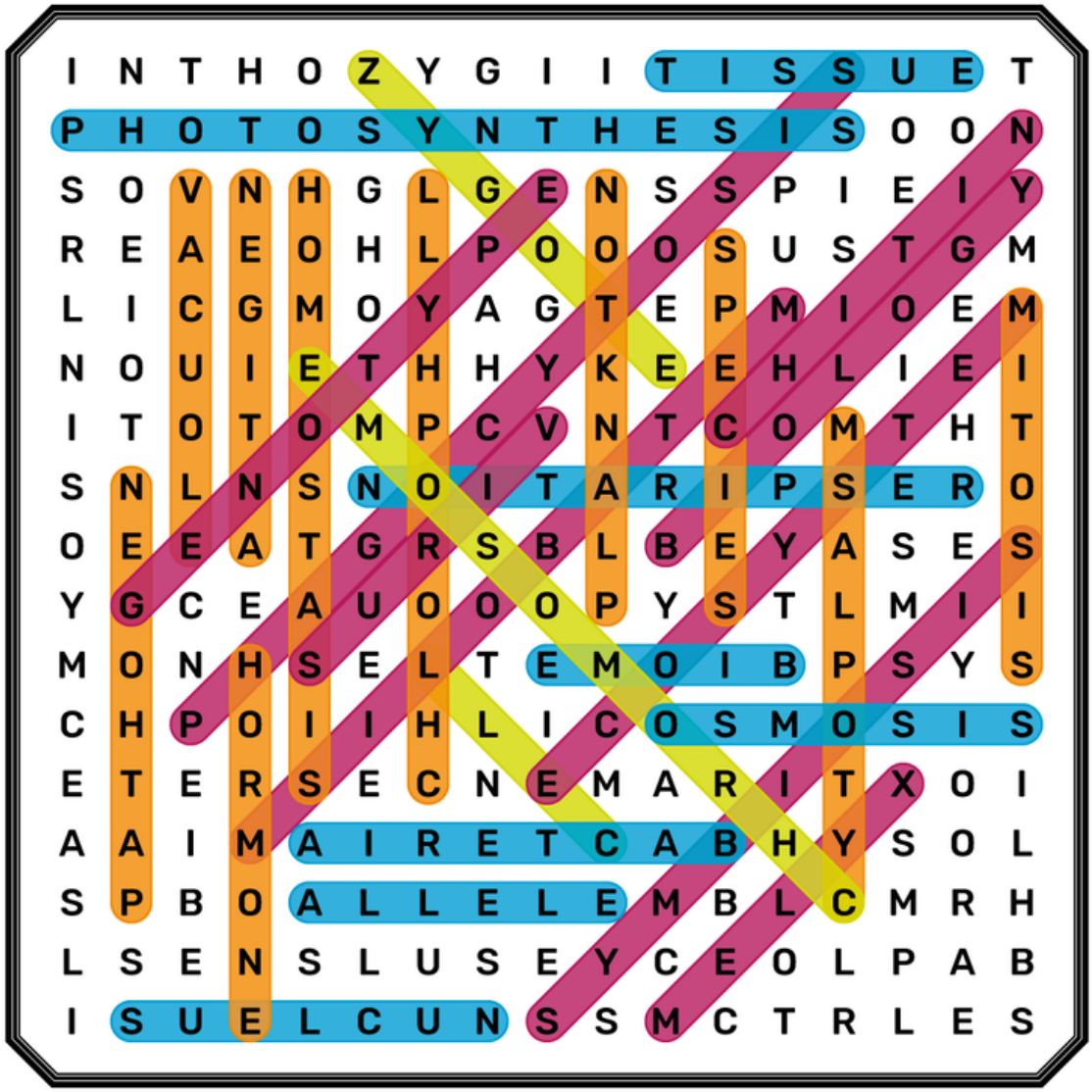
ANSWERS AT THE BACK

Crossword Answers

1. Cracking
2. Alkane
3. Fraction
4. Flammable
5. Hydrocarbon
6. Unsaturated
7. Monomers
8. Viscosity
9. Alkene
10. Double
11. Saturated
12. Polymer

WORD SEARCH ANSWERS

Life Science Word Search



Allele
Antigen
Bacteria
Biology
Biome
Cell
Chitin
Chlorophyll
Chromosome
Cytoplasm
Ecosystem
Genotype
Homeostasis
Hormone
Metabolism
Mitosis
Nucleus
Osmosis
Pathogen
Phagocytosis
Photosynthesis
Plankton
Respiration
Species
Symbiosis
Tissue
Vacuole
Virus
Xylem
Zygote

RIDDLE ANSWERS

1. Carbon dioxide

2. Teeth

3. Wetlands

4. A river

5. A palm tree

6. They both weigh the same

7. Energy

Cool Things to Check Out

COMPETITIONS:

- HTTPS://WWW.IMMERSE.EDUCATION/ESSAY-COMPETITION/#SCROLL2

COURSES:

- HTTPS://WWW.COURSERA.ORG/LEARN/CHEMISTRY-1
- HTTPS://WWW.COURSERA.ORG/LEARN/FUTURE-OF-ENERGY