8 Science Name:

STSE: Artificial Organs

**Science Fiction Comes Alive as Researchers Grow Organs in Lab**

Reaching into a stainless steel tray, Francisco Fernandez-Aviles lifted up a gray, rubbery mass the size of a fat fist. It was a human cadaver heart that had been bathed in industrial detergents until its original cells had been washed away. Next, said Dr. Aviles, "We need to make the heart come alive."

Dr. Aviles and his team are at the sharpest edge of the bioengineering revolution that has turned the science-fiction dream of building replacement parts for the human body into a reality. Since a laboratory made a bladder in 1996, scientists have built increasingly more complex organs. There have been five windpipe replacements so far. A London researcher, Alex Seifalian has made an artificial nose he expects to transplant later this year in a man who lost his nose to skin cancer.

Now researchers are tackling the most complex organ yet. The payoff could be huge, both medically and financially, because so many people around the world are afflicted with heart disease. Researchers see a multi-billion-dollar market developing for heart parts that could repair diseased hearts and clogged arteries. He sees a time when scientists would grow the structures needed for artery bypass procedures instead of taking a vein from another part the body. The development of lab-built body parts is being spurred by a shortage of organ donors and rising demand for transplants. Also, unlike patients getting transplants, recipients of lab-built organs won't have to take powerful anti-rejection drugs for the rest of their lives. That's because the bioengineered organs are built with the patients' own cells.

Until the late 1980s, few scientists believed it would be possible to make human organs because it was a struggle to grow human cells in the laboratory. The task became easier once scientists figured out the chemicals—known as growth factors—that the body itself uses to promote cellular growth. Scientists started out growing simple organs. In 1999, Anthony Atala implanted lab-grown bladders into several children with severely dysfunctional bladders. The organs have continued to function well for several years. In 2011, Dr. Seifalian made a windpipe from a patient's cells. It was used to replace the cancerous windpipe of the patient, saving his life.

The key to all the lab-built organs are stem cells, found in human bone marrow, fat and elsewhere. Stem cells can be transformed into other tissues of the body, making them the basic building blocks for any organ. In the case of the nose, stem cells extracted from the patient's fat tissue were added to the artist's mold, along with chemicals that control cell development. However, the nose was missing a crucial piece: skin. No one has made natural human skin from scratch. Dr. Seifalian's idea: to implant the nose under the skin of the patient's forehead in the hope that skin tissue there would automatically sheath the nose. But the patient objected, and for good reason: The implanted nose would have to sit inside his forehead for weeks or even months. In the end the bioengineered nose was implanted under the patient's forearm.

The team now is using imaging equipment to keep tabs on whether the necessary blood vessels, skin and cartilage are forming in the right way. "We'll have to also make sure there's no infection," Dr. Seifalian.

If the skin graft works, surgeons will remove the nose from the arm and attach it to the patient's face. "The whole process could take six months," said Dr. Seifalian. He estimates the cost of making the nose in the lab is about $40,000, but the patient isn't being charged because the doctors and scientists are either donating their time or working on this as part of their research. Dr. Seifalian said the new nose could restore some sense of smell to the patient, but its main benefit will be cosmetic.

Regenerating a nose would be a striking achievement; creating a complex organ like the heart would be historic. A team led by Spain's Dr. Aviles is trying to get there first. Dr. Aviles became frustrated with the difficulty of treating patients with advanced heart disease. The only option for the worst cases was a heart transplant, and there was a shortage of hearts. He was approached in 2009 by a U.S. scientist, Doris Taylor, who had already grown a beating rat heart in the lab.

Growing a heart is much harder than, say, growing a windpipe, because the heart is so big and has several types of cells, including those that beat, those that form blood vessels, and those that help conduct electrical signals. Mimicking the heart isn't easy. For example, more than a gallon of blood courses through the human heart each minute. In addition, the heart cells must be given the right electrical connections.

Dr. Aviles said he hopes to have a working, lab-made version ready in five or six years, but the regulatory and safety hurdles for putting such an organ in a patient will be high. The most realistic scenario, he said, is that "in about 10 years" his lab will be transplanting heart parts. He and his team already have grown early-stage valves and patches that could be used some day to repair tissue damaged by heart attack.

The Madrid lab has made only baby steps toward its grand plan to grow a human heart using the same techniques that Dr. Taylor pioneered with a rat heart. "We opened the door and showed it was possible," she said. "This is no longer science-fiction. It's becoming science."

Questions

1. What is an advantage of growing artificial organs? (1 marks)
2. What is a disadvantage of growing artificial organs? (1 marks)
3. What other organs do you think scientists should try to grow? Why would they be necessary? (2 marks)
4. Should artificial organs/body parts be available for plastic surgery at a price? (2 marks)
5. Would you put an artificial organ in your body? (2 marks)
6. What are some possible ethical issues with growing artificial organs? (2 marks)

Total: \_\_\_\_\_/10 = \_\_\_\_\_%