

WEBQUEST

Walking Away from Spinal Cord Injury: A Look at Physics and Engineering in Biology

In 1978, actor Christopher Reeve was flying high as Superman. When a fall from a horse left him paralyzed in a 1995, he became one of the country's best-known advocates for spinal cord injury research. Perhaps you have heard about Christopher Reeve, but you probably don't know about Sammy Hughes. In September of 2000, Sam was looking forward to completing football season and starting wrestling. Then a game injury left him returning to school permanently paralyzed. He was an average kid, just like you, one of the 1000 people who injure their spinal cords every year. Young people, ages 15 – 25, are the group most at risk.

How does this happen? How does an injury to the spinal cord cause paralysis? Why is it so often permanent? Have you heard that some nerves just don't seem to repair themselves? One day we all hope that stem cell research will be able to cause spinal cord injuries to heal, but what about now? What can we do about spinal cord injuries today?

There is no cure for a damaged spinal cord right now, but there is some help. Like most real problems, however, spinal cord injury and its complications require the knowledge and methods of a large group of scientists and engineers. As you work your way through this investigation, keep in mind these two **CENTRAL QUESTIONS**...

1. How did the creation of a technological solution (the Parastep FES system) require the work of a diverse group of scientists and engineers? How is this a model for how science is done? (Be specific first, naming the types of people you encountered in your search and telling how they contributed. Then generalize to the overall roles that physicists, biologists, health professionals and engineers play in medical advances.)
2. How can we justify the cost of this type of treatment? You are a doctor at a rehabilitation facility. Write a letter to your patient's insurer, MegaMed Insurance, to convince them to pay for her Parastep system. Include its cost and any reasons that might convince them to provide this care.

You'll come back to these a little later, but first you'll need some background information...

The Normal Nervous System

Let's start out by learning something about the spinal column and nervous system. Go to the following websites and find the answers to these questions. The answer to any question may be on only one site or may be on all of them. Read all of the questions in this section before you begin.

<http://faculty.washington.edu/chudler/cells.html>

<http://web.sfn.org/content/Publications/BrainBackgrounders/communication.htm>

<http://faculty.washington.edu/chudler/ap.html>

1. Draw a neuron and label its parts. Give the function for each part.
2. Explain how one neuron communicates with another.
3. Describe what happens when a neuron "fires" or sends a signal.
4. Think a minute... if an action potential is "all or nothing," then how does your brain tell "cool" from "cold" or "freezing?" (There are several ways... try to come up with an answer!)

Spinal Cord Injury Trauma

Paralysis usually results from some sort of jolt (“trauma”) to the spine. That is not the whole story, however. Visit this site to find out what really happens in a spinal cord injury.

<http://www.sci-recovery.org/sci.htm#level>

<http://depts.washington.edu/rehab/sci/research01.html>

http://www.ninds.nih.gov/disorders/sci/detail_sci.htm#39293233

1. What affects the severity of a spinal cord injury?
2. Many of us might guess that the damage done in a spinal cord injury is done by tearing or severing the neurons. What is the more common cause of damage in these situations? Explain in detail the process that kills the neurons.

Living With Spinal Cord Injury

As recently as the Second World War, patients with paralysis often died from complications in the few weeks. Now that they are living nearly a normal life span, the effects of living with paralysis long-term can create serious medical challenges. Read about them here.

http://www.spinalinjury.net/html/_complications_of_a_spinal_cor.html

1. A patient survives a spinal cord injuring accident. What kinds of complications will they face due to their new condition? Give a *very short* description of each.
2. From that long list pick the four that you think are the most serious and explain your choices.
3. There is a major problem left off of this that too often leads to death. Think about this and guess what that complication might be. Explain how the associated deaths might be prevented.

A Therapy From Physics and Engineering

While there is not yet a cure for a damaged spinal cord, there is a therapy that can address many of the complications. Read about it here.

<http://www.musclepower.com/poym2.htm>

<http://www.sigmedics.com/FESQandA/fesqanda.html#TheParastepSystem>

1. Explain what FES is and how it works.
2. What benefits might be achieved through the use of either an ERGYS or Parastep system?
3. Why might a patient prefer a Parastep system over an ERGYS bike? Why might someone else prefer the ERGYS system?

CONCLUSION

Now that you have looked at the operation of the nervous system, paralysis (and its complications) caused by spinal cord trauma and the operation and benefits of functional electrical stimulation, you are ready to go back and answer the CENTRAL QUESTIONS we looked at before. Here they are again...

1. How did the creation of a technological solution (the Parastep FES system) require the work of a diverse group of scientists and engineers? How is this a model for how science is done? (Be specific first, naming the types of people you encountered in your search and telling how they contributed. Then generalize to the overall roles that physicists, biologists, health professionals and engineers play in medical advances.)
2. How can we justify the cost of this type of treatment? You are a doctor at a rehabilitation facility. Write a letter to your patient's insurer, MegaMed Insurance, to convince them to pay for her Parastep system. Include its cost and any reasons that might convince them to provide this care.

Take your time with these questions and put plenty of thought into them!