

# Case Study: John Woodbury

## Case Presentation

John is 44 years old. He is sitting in the chair in the examination room. As he moves to the table, he stumbles on the carpet, laughs at himself and says that happens all the time.

John has enjoyed a relatively healthy life with no major illnesses. He is happily married with four children, ages 14, 11, 8, and 5.

You ask what prompted his visit. John responds, “I was out sailing and noticed I couldn’t hold onto the ropes as tightly as was needed. I’ve noticed a pattern of general weakness—legs, arm, hands, even my jaw—sneaking up on me lately and I thought I should check it out.”

On a separate sheet of paper, fill in the following chart, adding as many rows as needed:

WHAT WE KNOW	WHAT WE THINK WE KNOW	WHAT WE WANT TO FIND OUT

What is your hypothesis? (*Keep in mind this is simply a starting point and you will get more information later that will most likely change your hypothesis*).

Directed questions:

1. What are the major systems of the body?
2. What systems seem to be affected in John’s case?
3. What are the cell types specific to these systems? Draw and label the cells and describe their function.
4. List several possible conditions John could be suffering from.

# Case Study: John Woodbury

## Part 2

John appears relaxed and alert. He falls in the average range for weight given his age and height. You take his vital signs: temperature, pulse, respiratory rate, and blood pressure are all normal.

You ask John to swallow and you note he has some difficulty doing so. He states that is a common issue recently.

You test his gag reflexes. As the tongue depressor reaches his lips, he gags. You determine that John has an overactive reflex.

He does exhibit a general muscle weakness—he can overcome a lowered resistance, but not full resistance in most cases.

On a separate sheet of paper, fill in the following chart, adding as many rows as needed:

WHAT WE KNOW	WHAT WE THINK WE KNOW	WHAT WE WANT TO FIND OUT

What is your hypothesis?

Directed questions:

5. What is a neuromuscular junction? Draw and label a neuromuscular junction.
6. What are the effects of damage to upper motor neurons?
7. What are the effects of damage to lower motor neurons?

# Case Study: John Woodbury

## Part 3

You test John's reflexes and they were all normal, with the exception of the plantar reflex, also known as Babinski's sign. (See picture). His toes spread and extended.



You decide to order an MRI and an electromyography.

On a separate sheet of paper, fill in the following chart, adding as many rows as needed:

WHAT WE KNOW	WHAT WE THINK WE KNOW	WHAT WE WANT TO FIND OUT

What is your hypothesis?

Directed questions:

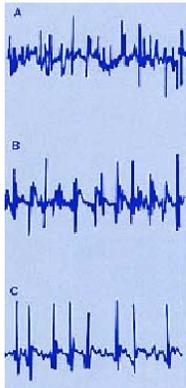
8. What conditions could cause an abnormal Babinski sign?
9. What are you looking for in the MRI and electromyography?

Resources: <http://endeavor.med.nyu.edu/neurosurgery/index.html>

# Case Study: John Woodbury

## Part 4

The results of John's MRI and electromyography are in.



Normal myogram



J. Woodbury myogram



Normal MRI



J. Woodbury MRI

On a separate sheet of paper, fill in the following chart, adding as many rows as needed:

WHAT WE KNOW	WHAT WE THINK WE KNOW	WHAT WE WANT TO FIND OUT

What is your hypothesis?

Directed questions:

10. What is an action potential? What factors influence the rate of action potentials?
11. What is a synapse? What events happen at a synapse?
12. What conditions could cause an abnormal myogram like the one shown above?
13. What conditions could cause an abnormal MRI like the one shown above?

## Case Study: John Woodbury

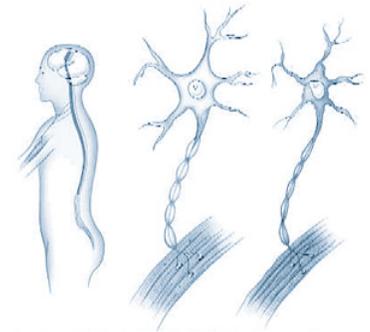
### Part 5

You run a blood test. John's serum (this is the part of the blood that does not include red and white blood cells or platelets) is abnormal. He has elevated levels of Glutamate.

On a separate sheet of paper, fill in the following chart, adding as many rows as needed:

WHAT WE KNOW	WHAT WE THINK WE KNOW	WHAT WE WANT TO FIND OUT

What is your hypothesis?



Directed questions:

14. What condition does John Woodbury likely have?
15. What course of treatment would you recommend?

# Case Study: John Woodbury

## Part 6

You refer John Woodbury to a Neurologist for a second opinion regarding your diagnosis of Amyotrophic Lateral Sclerosis. You also recommend a physical therapist and write out a drug prescription for Riluzole.

On a separate sheet of paper, fill in the following chart, adding as many rows as needed:

WHAT WE KNOW	WHAT WE THINK WE KNOW	WHAT WE WANT TO FIND OUT

What is your hypothesis?

Directed questions:

16. What challenges will John likely face in the future?
17. Find three charity groups that work with this condition.
18. What can physical therapy do for John Woodbury?
19. How does Riluzole act in the body?
20. Would you recommend any other specialists for John and his family?
21. Would you recommend genetic screening for his four children?

Images by:

**David Holland**  
Neurological Disorders  
UT Southwestern Medical Center

And

**The Eleanor and Lou Gehrig**  
MDA/ALS Research Center  
The Neurological Institute of New York  
Columbia University

And

**Stephen Russell and Marc Triola**  
NYU School of Medicine

## **Teacher Resource: Nervous System / ALS** **Problem Based Learning Unit**

Many colleges are using Problem Based Learning (PBL) in their science courses to encourage students to think critically and creatively about a particular topic. The nature of this educational tool is such that students are empowered to decide the direction of their research. By giving students necessary information piecemeal, they have time to focus on details while being motivated by the larger goal: solving the problem. This strategy is easily modified for the high school curriculum.

This particular PBL is designed to teach students about the Nervous System and Amyotrophic Lateral Sclerosis, better known as Lou Gehrig's Disease. The systems of the body and representative cell types are often taught through teacher-directed lessons. I thought it would be more engaging for my students to learn about Human Biology through an inquiry-based lesson. For example, comparing a normal myogram to one of an ALS patient and then going to their book to see what those "spikes" mean can teach the student the concept of the action potential. In this format, the Nervous System is much more exciting from the student's point of view.

The lesson plan can challenge any level of student because general biology classes can keep to the basics while advance college bound students can explore the molecular and genetic aspects of ALS. Although originally designed as a group project, there is no reason an individual cannot complete the exercises by him or herself.

The project should be done in six parts, giving students time between each section to find the answers to their questions and propose appropriate hypotheses. Given enough class time and computers in the room, several sections could be addressed in a single class. Otherwise, giving a single section per class period is advisable—this allows students to work on the research piece at home and does not require computers for individuals in the classroom.

One assessment option would be a skit showing doctor/patient interactions. Alternately, the directed questions could be used on a quiz or test.

One variation I would consider is separating the directed questions from the rest of each section. The questions are meant to keep students focused and give them hints as to how to proceed. Unfortunately, they may also stifle creativity. By giving them out after an initial brainstorming session, many difficulties can be avoided.

## Answer Key

1. What are the major systems of the body?

*Nervous, muscular, skeletal, integument, endocrine, cardiovascular, respiratory, reproductive, digestive, lymphatic, urinary*

2. What systems seem to be affected in John's case?

*Nervous and muscular*

3. What are the cell types specific to these systems? Draw and label the cells and describe their function.

*Nervous system: neurons*

*Muscular system: muscle cell*

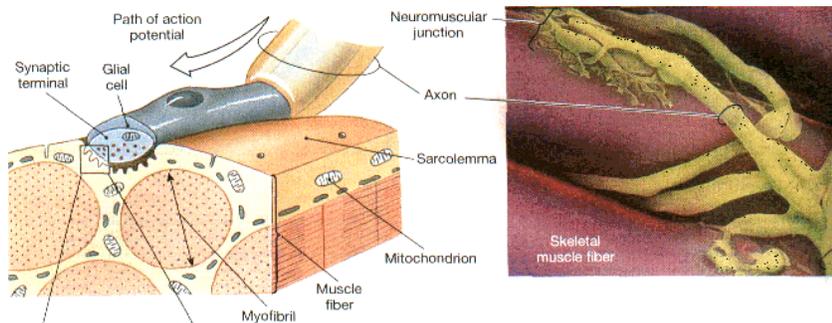
Refer to: <http://butler.cc.tut.fi/~malmivuo/bem/bembook/02/02.htm>

4. List several possible conditions John could be suffering from.

*HIV, Lyme disease, Multiple Sclerosis, Muscular Dystrophy*

5. What is a neuromuscular junction? Draw and label a neuromuscular junction.

*The place in the body where a neuron meets (or innervates) a muscle cell.*



(members.shaw.ca/ copingwithillness/junction.gif)

6. What are the effects of damage to upper motor neurons?

*These are motor neurons in the brain—damage results in abnormal, hyperactive reflexes*

7. What are the effects of damage to lower motor neurons?

*These are motor neurons in the spinal cord—damage results in muscle weakness*

8. What conditions could cause an abnormal Babinski sign?

Refer to: <http://www.nlm.nih.gov/medlineplus/ency/article/003294.htm>

- Amyotrophic lateral sclerosis
- Brain tumor (if it occurs in the corticospinal tract or the cerebellum)
- Familial periodic paralysis
- Friedreich's ataxia
- Head injury
- Hepatic encephalopathy
- Meningitis
- Multiple sclerosis
- Pernicious anemia
- Poliomyelitis (some forms)
- Rabies
- Spinal cord injury
- Spinal cord tumor
- Stroke
- Syringomyelia
- Tuberculosis (when it affects the spine)

9. What are you looking for in the MRI and electromyography?

*electromyography(EMG): a special recording technique that detects electrical activity in muscles. If the nerve cells diseased, the rate of action potentials being fired may be abnormal.*

*magnetic resonance imaging (MRI): a magnetic field and radio waves are used to look at soft tissue of the body. An MRI of the brain could show damage to the brain.*

10. What is an action potential? What factors influence the rate of action potentials?

*An action potential is an electrical impulse that travels the length of an axon, which triggers a chemical signal to be sent to the next cell.*

*The strength of a stimulus, the duration of a stimulus, the health of the myelin sheath, etc*

11. What is a synapse? What events happen at a synapse?

*A synapse is the space between a nerve cell and it's target cell (which could be another nerve cell or a muscle cell).*

*At the synapse, the action potential triggers an influx of Calcium ions. This triggers presynaptic vesicles to bind with the cell membrane and release its contents of neurotransmitter into the synapse. The neurotransmitter diffuses across the synapse and binds with a postsynaptic receptor on the second cell. This is a chemically gated transport protein that is now open and allows ions to flow into the second cell, triggering a new action potential in the second cell.*

12. What conditions could cause an abnormal myogram like the one shown above?

Refer to: <http://www.nlm.nih.gov/medlineplus/ency/article/003929.htm>

- Denervation (reduced nervous stimulation)
- Carpal tunnel syndrome
- Amyotrophic lateral sclerosis (ALS)
- Myopathy (muscle degeneration, may be caused by a number of disorders, including muscular dystrophy)
- Myasthenia gravis
- Alcoholic neuropathy
- Axillary nerve dysfunction
- Becker's muscular dystrophy
- Brachial plexopathy
- Cervical spondylosis
- Common peroneal nerve dysfunction
- Dermatomyositis
- Distal median nerve dysfunction
- Duchenne muscular dystrophy
- Facioscapulohumeral muscular dystrophy (Landouzy-Dejerine)
- Familial periodic paralysis
- Femoral nerve dysfunction
- Friedreich's ataxia
- Guillain-Barre
- Lambert-Eaton Syndrome
- Mononeuritis multiplex
- Mononeuropathy
- Peripheral neuropathy
- Radial nerve dysfunction
- Sciatic nerve dysfunction
- Sensorimotor polyneuropathy
- Shy-Drager syndrome
- Thyrotoxic periodic paralysis
- Tibial nerve dysfunction
- Ulnar nerve dysfunction

13. What conditions could cause an abnormal MRI like the one shown above?

Answers will vary. Many ALS patients have normal MRI's

14. What condition does John Woodbury likely have?

*Amyotrophic Lateral Sclerosis*

15. What course of treatment would you recommend?

*Riluzole*

16. What challenges will John likely face in the future?

*After diagnosis, the life span is 3-5 years on average. Patients suffer a gradual weakening of the muscles, difficulty swallowing, loss of speech, muscle cramps and spasticity, periods of laughing and crying. After a certain point, John will need help breathing (via machines), eating (through a tube), and will be bedridden.*

17. Find three charity groups that work with this condition.

*ALS Association*

*Curt and Shonda Shilling Striking Out ALS*

*(Answers will vary)*

18. What can physical therapy do for John Woodbury?

*PT will “strengthen unaffected muscles, improve cardiovascular health, and help patients fight fatigue and depression”. ([http://www.ninds.nih.gov/disorders/amyotrophiclateral sclerosis/detail\\_ amyotrophiclateral sclerosis.htm](http://www.ninds.nih.gov/disorders/amyotrophiclateral sclerosis/detail_ amyotrophiclateral sclerosis.htm))*

*As the disease progresses, physical therapists will help John find appropriate braces and other means to keep him mobile.*

19. How does Riluzole act in the body?

*Riluzole breaks down glutamate in the body. Excess glutamate has been found to degrade motor neurons. By destroying some of the glutamate, it is hoped that nerve cell death rate will decrease.*

20. Would you recommend any other specialists for John and his family?

*I would probably recommend a psychologist to help them cope with all of the emotional aspects of hospice care—especially considering John’s age and the ages of his wife and children.*

*(Answers will vary)*

21. Would you recommend genetic screening for his four children?

*(Answers will vary)*