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Independent Study & Mentorship

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Mighty Magnets

Assessment 8 - Research

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Subject: Magnetic Resonance Imaging

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Klioze, Doctor. "MRI: Basic Physics & a Brief History." *Youtube.com,* 5 November 2013, Accessed 24 Oct. 2018.

Korsmo, Mike. "MRI Sequences." *Youtube.com*. 1 August, 2015, Accessed 24 Oct. 2018.

"Magnetic resonance imaging (MRI)." *The Gale Encyclopedia of Science*, edited by K. Lee Lerner and Brenda Wilmoth Lerner, 5th ed., Gale, 2014. *Science In Context*, http://link.galegroup.com/apps/doc/CV2644031351/SCIC?u=j043905010&sid=SCIC&xid=89ab8cbc. Accessed 24 Oct. 2018.

Assessment:

In the past, diagnosis of the brain and other parts of the nervous system was nearly impossible since physically examining such delicate structures was simply not viable with living

human patients. However, in the 20th century, the development of numerous types of medical technology due to increased knowledge about physical processes has allowed studying and even diagnosing diseases related to the nervous system to become much easier. Thus, the purpose of this assessment is to examine Magnetic Resonance Imaging (MRI) scans, their basic structure, and different sequences that can be used in order to diagnose illnesses.

MRI scans are able to operate due to the interaction of atomic protons, most notably in hydrogen, with a strong magnetic field and radio frequency energy. The protons either line up with or against the magnetic field that is imposed upon them, and protons lining up against the magnetic field indicate that a large amount of energy is being stored. This makes sense because in AP Chemistry, protons and their ability to dictate different characteristics of an element has been made apparent multiple times. In fact, the concept of protons lining up mostly in the same direction due to magnetism was discussed in the previous unit, so it was exciting to see that knowledge from other classes was helping my ISM journey. Although most protons point towards the magnetic field, transmitting a radio frequency can flip some protons into a higher energy state, and this helps achieve a longitudinal magnetization of 0. Once the radio frequency is removed, the positive charges in protons cause them to repel each other, and thus T2 Relaxation occurs. T1 Relaxation occurs next, and both of these together are different for different body molecules, thus allowing MRI scans to create grayscale imaging. For example, water appears brighter and fat molecules appear darker. This makes sense because in AP Biology, the structures of different biomolecules were discussed, and since fats are composed of more hydrogens, they are more susceptible to quickly giving up absorbed energy with the dispersion of protons. Although the physics and chemistry behind how an MRI scan works was

quite complicated to understand, I have gained a solid preliminary understanding. In addition, since Dr. Dike majored in physics, I can ask him to clarify the physics concepts behind MRI scans for me. Most importantly, this introduction to MRI scans has shown me how all three main branches of science are important in medicine, so I must excel in all in order to establish a career in this field.

In order to gain more clarity on MRI, different MRI sequences were also explored through the use of another medical school video. In the previous video, it became apparent that T1 and T2 Relaxation are induced by the exact opposite conditions, and seeing how even the colors for the different tissues is different on the scan made this distinction even more clear. For example, in T1, fat is bright and water is dark, and in T2, the opposite is true.

I found the Diffusion Weighted Imaging (DWI) Sequence to be the most interesting because it is the only one that can diagnose an ischemic stroke. Previously, I have done an assessment over strokes, and ischemic strokes are caused by narrowed or blocked arteries, so it makes sense why other MRI sequences, which only pick up a difference between solid and fluid masses, would not be able to detect a stroke. During my summer shadowing experience with Dr. Dike, he showed me multiple MRI images and pointed out different strokes, so it becomes apparent that he uses DWI in his clinic.

Using my newly acquired knowledge, I feel more confident in interpreting an MRI scan, but there is much more to learn and I have found more advanced videos that can be watched for future assessments. Nonetheless, since my Original Work relates to completing a patient case study and using tests such an MRI scan to diagnose a disease, the information learned from this

assessment is quite valuable: not only to my original work, but also to my future in medicine and neurology.