

Tearing Down the Wall of Pain

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Junior Division

Individual Documentary

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Documentary Links

This History Day documentary is available to view online through the following link or links:

<https://vimeo.com/407726015>

https://youtu.be/1MUzb4_r4j8

https://www.youtube.com/watch?v=1MUzb4_r4j8&feature=youtu.be

Process Paper

I have two physicians as parents. Since I can remember, they are constantly teaching me about how the body works, the different types of diseases there are, and their treatments. I have always wondered about how drugs relieved pain and caused unconsciousness.

I thought that the discovery of anesthesia would be a good subject for National History Day. Today, we take it for granted but there was a time when we did not have drugs to allow us to undergo surgery painlessly. Since the theme was breaking barriers, I thought that the discovery of anesthesia could represent breaking the barrier of pain during surgery.

I chose to do a documentary because a film is visual, and an effective way to present my theme. This would challenge me to tell the story by writing the script, setting up the images and using my computer skills. This would also be good practice for my future goals in making films.

After I had chosen both my topic and format, I started gathering research on the history and evolution of anesthesia. I used books, online resources, and primary documents from the University of Washington libraries. A very helpful source was the Wood Library-Museum of Anesthesiology website. I also visited the Anesthesia Heritage Centre in London, UK, which had displays of original materials.

I decided to interview people who work in the field of anesthesia, to gain their perspectives on how it has benefitted society. Two of the interviewees are my mother's colleagues, Dr. Anne Wong and Dr. Carol Barrese, and Dr. Frank Schramm works with my father. I communicated with them through email. Dr. Wong's and Dr. Barrese's interviews were done using Zoom.com, a video conferencing app. I met with Dr. Schramm at his office for his interview. I filmed using an iPhone attached to a tripod and I recorded the session using a portable microphone.

I read that the developer of propofol, an anesthetic drug used widely around the world, was Dr. John (Iain) Glen, who lives in England. I decided to email him, and was excited that he responded. We spoke on the telephone, and he agreed to be interviewed. However, we couldn't do video-conferencing since he did not have a camera on his computer. Since we were going to be in England for winter break, we decided to meet with him there.

I learned through this project that the first demonstration of the use of ether was a turning point for both the practice of surgery as well as for society, in that, from then onwards, the idea of painless surgery became possible. A barrier — scientific, physical, and mental — was truly broken. The other thing I learned was how much work there was in preparing for a documentary. There was a lot of material to review, and I learned to use features in iMovie that I didn't know before. Overall, I enjoyed the entire process, and hope that my film shows that an important barrier in society had been broken.

Annotated Bibliography

Sources:

Anaesthesia. (n.d.). Retrieved from Brought to Life website:

<http://broughttolife.sciencemuseum.org.uk/broughttolife/techniques/anaesthesia>

This article gave a very condensed, brief summary of the history of anesthetics up until the 1940s. I learned about the ancient plant remedies used during the times of early civilization, the breakthrough of the three anesthetic gases (nitrous oxide, ether, and chloroform) in the 1800s, the invention of the intravenous anesthetics in the 1920s, and the first muscle relaxants in the 1940s.

Anderson, A. (Director). (2011). *A walk through the use of anesthesia* [Motion picture].

United States: Grinnell Regional Medical Center.

This video taught me what happens in the operating room before, during, and after an operation occurs. I received a walkthrough of how to use all of the equipment and machines, as well as how to administer particular drugs.

The anesthesia era: 1845-1875. (2018, March 10). *The ASCO Post*. Retrieved from

<https://www.ascopost.com/issues/march-10-2018/the-anesthesia-era-1845-1875/>

This article mainly focused on the three men other than Dr. Morton who tried to each tried to name themselves the discoverer of anesthesia: Dr. Horace Wells, Dr. Crawford Long, and Mr. Charles Jackson. I learned about the background of these men, and how they all came to experimenting with anesthetic gases.

Aptowicz, C. O. (2014, September 4). The dawn of modern anesthesia. *The Atlantic*.

Retrieved from <https://www.theatlantic.com/health/archive/2014/09/dr-mutters-marvels/378688/>

This article focused primarily on Dr. Wells and Dr. Morton. It discussed how nitrous oxide and ether were at first used for recreational purposes, and were noted for their abilities to induce unconsciousness. I learned about Dr. Wells failed demonstration of nitrous oxide at the Massachusetts General Hospital, and Dr. Morton's successful one with ether.

Aptowicz, C. O. (2014, September 25). Surgery in a time before anesthesia (op-ed).

***LiveScience*. Retrieved from <https://www.livescience.com/48003-anesthesia-was-once-devils-work.html>**

In this article, the main focus was mainly that of surgery before anesthesia was born. I learned about how surgery was painful for both the surgeon and that patient; it was difficult for a doctor to operate on a thrashing, squirming person, and the patient going under the knife had to be held down by the arms of several men, who were forced to ignore their cries and pleas so the surgeon could do his job.

Barrese, C. (2020, February 8). [Personal interview by the author].

With my interview with Dr. Barrese, as she is an anesthesiologist, I asked her many questions pertaining to different types of anesthetics, what they do to the body, what is on the horizon for the future of anesthesia, and her opinion on what truly broke the barrier of pain during surgery.

Blatner, A. (n.d.). THE DISCOVERY AND INVENTION OF ANESTHESIA (Stories in the History of Medicine). Retrieved from Adam Blatner's Web Site:

<https://www.blatner.com/adam/consctransf/historyofmedicine/4-anesthesia/hxanesthes.html>

This article summarized all of the different types of drugs throughout the history of anesthetics. This includes the herbal remedies used in ancient times, the three recreational gases, cocaine, and a lot of the more commonly known drugs, such as morphine.

Burney, F. (1986). *Selected letters and journals* (J. Hemlow, Ed.). Oxford: Oxford University Press.

Fanny Burney was a popular English novelist in the early 1800s. She once had a mastectomy for breast cancer, and she remained conscious during the surgery. In her work, *Selected Letters and Journals*, she wrote about the agony she had experienced during the operation. I used her vivid and mortifying description as an example to show what surgery was like without anesthesia.

Campbell, J. (Director). (2016). *Pain pathways* [Video file].

In this video, I was taught how a signal of pain in an injured part of your body travels to your brain and back. I learned about how the neurons in your body transmit messages from your limbs to your brain and back again.

Carruthers, A. (2015, October 16). *World anaesthesia day: Key events in the history of anaesthesia*. Retrieved from OUPblog website:

<https://blog.oup.com/2015/10/anaesthesia-day-history/>

This article taught me about the origins and the different contributors who made up the entire story of anesthesia. I learned about the different types of drugs discovered and how that affected the way surgery was performed.

Centennial of the discovery of anesthesia. (1938). *Southern Medical Journal*, 31(11), 1212-1213.

This source gave another perspective as to who truly discovered anesthesia. Surgeon Crawford Williamson Long was truly the first who found the anesthetic properties of ether, and he also used it on his patients for operations. However, he did not publish his work until seven years later, and by then, several others, such as William Thomas Green Morton (who had been the first to make his work successfully public), were claiming the name of the discoverer. This article, however, claimed Long as the discover. It gave me more information about the surgeon's background and his experiments with ether.

Cole, F. (1965). *Milestones of anesthesia*. University of Nebraska Press.

From this article, I could see, in his letters, Dr. Horace Wells's desperation to be known as the discoverer of propofol. This deeply contrasted with the solidarity and success of Dr. Morton's ether demonstration, which was what truly opened the world's eyes to anesthesia.

Dallas, M. E. (n.d.). 8 surprising facts about anesthesia. Retrieved 2019, from Everyday Health website: <https://www.everydayhealth.com/news/surprising-facts-about-anesthesia/>

This source let me know some statistics about people who go under anesthesia for surgery. For example, I learned that 60,000 people have surgery in one day in the US, and the operations are almost always accompanied with the help of modern anesthetics.

Dankoski, E. (2018). The 2018 Lasker~DeBakey Clinical Medical Research Award recognizes John Baird Glen for the discovery of propofol. *The Journal of Clinical Investigation*. <https://doi.org/10.1172/JCI124375>

In this article, I learned about how Dr. Glen, the discoverer of propofol, was awarded the Lasker-DeBakey Clinical Medical Research Award in 2018 for his contributions to the world of medicine. I learned more about his development of the drug as well as the advanced technology system he had devised to administer it.

Dutchen, S. (2011, January 26). The many mysteries of anesthesia. *LiveScience*. Retrieved from <https://www.livescience.com/11642-mysteries-anesthesia.html>

This source mainly discussed the events in the mid 1800s, when the three recreational/anesthetic gases emerged. I learned about the advancements of the agents at the time, and how they carried us into the future.

Ether and Chloroform. (2010, April 26). Retrieved April 21, 2018, from History website: <https://www.history.com/topics/inventions/ether-and-chloroform>

In this article, I learned about the developments in both ether and chloroform. I learned both about their effects on us as well as times each drug was famously used, such as chloroform on Queen Victoria for the birth of her first son, Prince Leopold.

Featherstone, P. (2011, December 11). Timeline of important dates and events in the development of anaesthesia. Retrieved from History of Anesthesia Society website: <http://www.histansoc.org.uk/timeline.html#>

This was a timeline of important advancements in the history of anesthesia. Therefore, I received a general overview of the beginning and the development of modern anesthetics.

***General anesthesia* [Motion picture]. (2015). United States: Covenant Health.**

This video showed me what different types of general anesthesia there are: intravenous and inhalational. I also learned what the anesthetics do to your body in order to induce unconsciousness.

Glen, J. (. B. (1980). Animal studies of the anaesthetic activity of ICI 35 868. *British Journal of Anaesthesia*, 52(8), 731-742. <https://doi.org/10.1093/bja/52.8.731>

Dr. John (Iain) Baird Glen was the veterinarian who discovered the renowned anesthetic and sedative, propofol. The way that he discovered propofol was by testing compounds given by the Imperial Chemical Industries Pharmaceuticals on animals. He wrote this article, and it explained to me in detail his experiments on the animals and the effects propofol had upon them.

Glen, J. (. B. (1982). The discovery and development of ICI 35868, a new intravenous anaesthetic. *Proceedings of the Association of Veterinary Anaesthetists*, 10, 201-203. <https://doi.org/10.1111/j.1467-2995.1982.tb00612.x>

John B. Glen was the discoverer of propofol, or as he referred to it back then, ICI 35868. He was trying to find an anesthetic that could replace thiopental, which was a popular barbiturate general anesthetic back in the 1970's. In this article, Dr. Glen recorded the different effects thiopental and propofol had on test-animals. I learned about the difference in the speed of onset and offset between the two drugs.

Glen, J. (. B. (2018). Balancing tricks and mini-pigs: Steps along the road to propofol. *Cell*. <https://doi.org/10.1016/j.cell.2018.08.009>

This article, also written by Dr. John Glen, provided not only the steps in developing propofol, but also his background story. I learned about his life on a farm as a boy, and

about his interest in experimenting with chemical agents. This ultimately led to his discovery of propofol while testing compounds to see if they could make good anesthetics.

Glen, J. (. B. (2019). Try, try, and try again: Personal reflections on the development of propofol. *British Journal of Anaesthesia*. <https://doi.org/10.1016/j.bja.2019.02.031>

This article discussed Dr. Glen's persistence in developing and perfecting propofol for human medicine. He spent thirteen years trying to do this, as well as to create an advanced-technology computer system to administer it. There were many obstacles along the way, but he eventually made it in 1989.

Glen, J. (. B. (2020, February 17). [Personal interview by the author].

From this interview with the discoverer of propofol, I learned Dr. Glen's background, how he became interested in testing chemical agents, and the challenges he faced while trying to develop propofol. He described the different types of drugs used at the time, and that he was looking for a drug with a faster onset. After he found propofol, and saw that it fit the criteria, he spent thirteen years trying to develop the drug as well as a high technology computer system to administer it. Propofol was finally approved for use in the United States in 1989.

Grzybowski, A. (2007). [The history of cocaine in medicine and its importance to the discovery of the different forms of anaesthesia] (K. Oczna, Trans.). Retrieved from PubMed database.

The coca plant has been used for both recreational and medicinal purposes for thousands of years. From this article, I learned about its ancient use, as well as its isolation and purification into cocaine in the 1860s. Cocaine was ultimately

popularized in human medicine in 1884, by Dr. Karl Koller, who showed the benefits of the drug at a conference.

Hilton, L., & Uretsky, S. (n.d.). Anesthesia, general. Retrieved from Encyclopedia of Surgery website: <https://www.surgeryencyclopedia.com/A-Ce/Anesthesia-General.html>

From this source, I received the true definition of anesthesia. I learned what it does to the body as well as the different kinds of anesthesia. I also learned the downsides of misusing anesthesia.

History of Anesthesia. (n.d.). Retrieved from Wood Library Museum of Anesthesiology database.

I retrieved much of my research from this source, as it provided primary artifacts and documents. It also summarized the history of anesthesia as a whole and gave the main points of advancement.

History of anesthesia. (n.d.). Retrieved from Medical Discovery News website: <http://www.medicaldiscoverynews.com/shows/anesth.html>

This article very briefly summarized the developments in the different types of drugs of anesthesia. It mentioned the crude forms of anesthesia in ancient times, which became more sophisticated in the 1800s, and developed even further in the early twentieth century.

Liley, D. (2017, May 1). A short history of anaesthesia: From unspeakable agony to unlocking consciousness. Retrieved from The Conversation website: <http://theconversation.com/a-short-history-of-anaesthesia-from-unspeakable-agony-to-unlocking-consciousness-74748>

In this source, the main subject described is the transition from unimaginable pain of surgery without anesthetics to Dr. Morton's demonstration to the ultimate popularization of anesthesia. I also learned that the actual mechanics of anesthesia within the human body remains to be a mystery.

Liu, L., Pei, D., & Soto, P. (2018, February 18). History of the opioid epidemic: How did we get here? Retrieved June 1, 2018, from <https://www.poison.org/articles/opioid-epidemic-history-and-prescribing-patterns-182>

This website gave me the whole history of how the opioid epidemic started, and how it has evolved throughout the years into what it is today. It described in detail the three major waves of opioid overdoses deaths, in 1999, 2010, and 2013, as well as how the rates have currently been rapidly increasing .

Markel, H. (2013, October 16). The painful story behind modern anesthesia. *PBS NewsHour*. Retrieved from <https://www.pbs.org/newshour/health/the-painful-story-behind-modern-anesthesia>

In this article, I found out a lot about the dispute as to who truly discovered anesthesia. I learned of the tragedy of Dr. Morton, Dr. Wells, and Mr. Jackson after Dr. Morton's demonstration. They were all so hungry for fame that it ended up killing them.

Medical Milestones: Discovery of Anesthesia & Timeline. (2015, November 11). Retrieved from The UMHS Endeavour website: <https://www.umhs-sk.org/blog/medical-milestones-discovery-anesthesia-timeline/>

This article highlighted Dr. Morton's public demonstration as the event which set off so many other advancements in anesthesia. This site, too, had a timeline, but they borrowed it from the Wood Library Museum.

Mohamed, F. (Director). (2018). *Pharmacology - general and local anesthetics (made easy)* [Motion picture]. United States: Speed Pharmacology.

This video described to me the different types of anesthesia, such as intravenous and inhalational. I learned a lot about the different types of drugs used to desensitize particular parts of the body.

***Neuroscience basics: Anesthesia, how it works, animation* [Motion picture]. (2017). United States: Alila Medical Media.**

In this video, I learned about how the chemicals in anesthetic drugs affect receptors in the human body. When they interfere with these receptors, they cause the patient to lose consciousness.

Nuland, S. B. (1983). *The origins of anesthesia* (Ed ed.). Classics of Medicine Library.

From this book, I learned about how one young man, named Humphry Davy, had been experimenting with nitrous oxide. He was the very first to realize that the gas could have surgical use. However, he did not follow up on his speculation, and so nitrous oxide would be left out of medicine for another half-century.

Oliver Wendell Holmes coins the term "anesthesia". (n.d.). In N. Rice (Author), *Trials of a public benefactor, as illustrated in the discovery of etherization* (p. 137). (Excerpted from *Trials of a public benefactor, as illustrated in the discovery of etherization*, p. 137, 1859, New York, United States: Pudney & Russells)

In this article, I learned the origins of the word "anesthesia." When it was discovered that ether could induce unconsciousness, and could also be used for surgery, Oliver Wendell Holmes, a physician, poet, and polymath, wrote a letter to Dr. William Thomas Green Morton, suggesting a name for the state and the agent. He wanted to

call it *Anaesthesia*, which is Greek for insensibility. This letter was found in a secondary source book published a little after a decade later.

Opioid basics. (n.d.). Retrieved March 19, 2020, from

<https://www.cdc.gov/drugoverdose/opioids/index.html>

This web page helped me understand the different types of opioids there are. For example, prescription opioids are prescribed by doctors to treat both moderate and severe pain, but can also have serious risks and side effects. Most of the opioids used nowadays are synthetic opioids, such as fentanyl, which is many times more powerful than other opioids, and is approved for treating severe pain.

***Physiology of pain, animation.* [Motion picture]. (2018). United States: Alila Medical Media.**

This source taught me a lot about the defense mechanism of pain. I learned about the signals sent from an injured body part to the brain and back again, and how this tries to make us learn from harmful mistakes.

Price, S. (2019, November 6). Snail venom to pain relief: How conotoxins can be used in pain therapy. Retrieved from Health Europa website:

<https://www.healtheuropa.eu/conotoxins-can-be-used-in-pain-therapy/94644/>

This article helped me see what is on the horizon for anesthesia. New technology is constantly being developed, and according to this source, the conotoxins from snail venom can be used to treat pain.

Schramm, F. (2020, January 31). [Personal interview by the author].

With my interview with Dr. Schramm, as he too is an anesthesiologist, and I asked him the same questions as Dr. Wong and Dr. Barrese, questions pertaining to different

types of anesthetics, what they do to the body, what is on the horizon for the future of anesthesia, and his opinion on what truly broke the barrier of pain during surgery.

The science of acupuncture BBC documentary traditional Chinese medicine [Motion picture].

(2014). England: BBC.

Acupuncture is an ancient Chinese practice that is thousands of years old. Today, it serves as an adjunct to surgery. This documentary showed how acupuncture can reduce pain in surgery, so much so that there was once even a successful heart surgery in China, with no anesthetics and only acupuncture to reduce the patient's pain.

Siegel, B. (2020, March 27). How anesthesia machines can help hospitals with ventilator shortages fight coronavirus. *ABC News*. Retrieved from

<https://abcnews.go.com/US/anesthesia-machines-hospitals-ventilator-shortages-fight-coronavirus/story?id=69829495>

This news article helped me understand why and how anesthetic machines are being converted into ventilators for patients severely affected by the coronavirus. There is apparently an anticipated shortage of ventilator machines in the US, and so, anesthesia machines are being modified in order to supplement the diminishing ventilators. I learned that although they were originally constructed to deliver oxygen and gas mixtures to place patients under anesthesia during surgical procedures, they can be altered to aid COVID-19 patients struggling to breathe on their own.

Smith, C. (1927). The Discovery of Anesthesia. *The Scientific Monthly*,24(1), 64-70.

This source gave me a detailed history about the race for becoming the discoverer of anesthesia. It gave the backstories of Dr. William Morton, Dr. Horace Wells, Dr. Crawford, and Dr. Charles Jackson, Dr. Morton's landlord, who supposedly gave Dr.

Morton the idea to purify ether and make it into an anesthetic. I learned about both the legal and the emotional drama that occurred throughout the discovery of anesthesia, and about the dispute as to who truly was the discoverer of anesthesia.

***Spinal and epidural anesthesia* [Motion picture]. (2015). United States: Covenant Health.**

This video showed me the uses for spinal and epidural anesthesia, and how to administer it. I learned the effects that the anesthesia has upon the body, completely paralyzing you below the location you injected the needle.

Sykes, K., & Bunker, J. (2007). *Anesthesia and the practice of medicine: Historical perspectives*. London, UK: Royal Society of Medicine Press.

This book demonstrated graphically what surgery was like before the discovery of anesthesia. It also gave me a detailed recount of *all* of the people who had experimented with the three gases, nitrous oxide, ether, and chloroform, whether or not they became known for their work.

Thomas, R. K. (2019). How ether went from a recreational 'frolic' drug to the first surgery anesthetic. *Smithsonian Magazine*. Retrieved from <https://www.smithsonianmag.com/science-nature/ether-went-from-recreational-frolic-drug-first-surgery-anesthetic-180971820/>

This article talked about the history of ether, and how it went to a party drug to a vital anesthetic in the 1800s. I learned about how Long was technically the first man to see the anesthetic properties in ether, but did not publish his work until much later, therefore making room for Dr. Morton to step in and show anesthetic ether the world with his demonstration.

***Understanding pain in less than 5 minutes, and what to do about it!* [Motion picture]. (2013).**

Live Active.

This was another video illustrating what pain actually is. I was given a definition of pain and a full breakdown of why we feel it when we injure ourselves.

Understanding the epidemic. (n.d.). Retrieved March 19, 2020, from

<https://www.cdc.gov/drugoverdose/epidemic/index.html>

I used this website to look at the statistics of opioid overdose deaths throughout the years. I learned about the three waves in opioid overdose deaths, and which types of opioids were most involved.

Watson, J. (1858). The invention of anesthesia—national testimonial to Dr. Wm. T. G.

Morton.. *New York Times (1857-1922)*, p. 2.

This is letter from John Watson, the Chairman of the Executive Committee of the New York Times, to the editor of the New York Times. The latter had apparently printed an article about who truly discovered anesthesia, and, as there was a major dispute as to whom it was, did not put the spotlight on a particular person. Mr. Watson wrote this letter to him to argue that there should be no doubt as to whom it was, as the claims of other "discoverers" only prove that Dr. William Thomas Green Morton is the only one worthy of being called the discoverer. This article showed me another perspective, probably the most popular perspective, as to who really was the first to find anesthesia: Dr. Morton.

What is the U.S. opioid epidemic? (n.d.). Retrieved September 4, 2019, from

<https://www.hhs.gov/opioids/about-the-epidemic/index.html>

This website gave me a general overview of what the opioid epidemic is. It also gave me some statistics about opioids throughout the years, such as the number of overdose deaths, the misuses of prescription opioids, and which specific types of opioids caused the deaths.

Wildsmith, T. (n.d.). The history of anaesthesia. Retrieved from RCoA website:

<https://rcoa.ac.uk/about-college/heritage/history-anaesthesia>

This article described how each of the three gases, nitrous oxide, ether, and chloroform, were discovered, and how they changed the face of medicine. I also read about major developments in drugs and subsequent events after Dr. Morton's demonstration.

Winters, R. (2016). *Accidental medical discoveries: How tenacity and pure dumb luck changed the world*. Skyhorse.

This book gave me an general overview as to who did what in the developments of nitrous oxide, ether, chloroform, and cocaine. This was the very first source from which I gathered basic information about the first advancements of anesthesia.

Wong, A. (2020, February 8). [Personal interview by the author].

With my interview with Dr. Wong, as she is also an anesthesiologist, I asked her the same questions as Dr. Barrese, pertaining to different types of anesthetics, what they do to the body, what is on the horizon for the future of anesthesia, and her opinion on what truly broke the barrier of pain during surgery.

Wood, M., & Stark, R. (2018, December). John (Iain) Glen wins 2018 Lasker Prize for development of propofol: An award for all of anesthesiology. Retrieved from

Anesthesiology website:**<https://anesthesiology.pubs.asahq.org/article.aspx?articleid=2708088>**

This article describes Dr. John Glen's journey in discovering propofol. I learned about his career and how he came to find propofol. I also found out that he was given the Lasker-DeBakey Clinical Medical Research Award for his groundbreaking discovery.

Zheng, S. (Director). (2015). *How does anesthesia work?* - Steven Zheng [Motion picture].**United States: TED-Ed.**

This video described the different types of anesthesia and how different types of administration affect the patient. I also learned that the different types of drugs can have different effects on a patient.

Image Sources:**StockSnap — <https://stocksnap.io>**

I used this website for generic images of anesthetized patients.

American Society of Anesthesiologists — <https://www.asahq.org>

I collected historic photos from this website.

Wellcome Collection — <https://wellcomecollection.org>

I collected primary documents and historic photos from this website.

Old Book Illustrations — <https://www.oldbookillustrations.com>

I gathered some illustrations of surgery without anesthesia from this website.

Ancient Origins — <https://www.ancient-origins.net>

I collected some historic illustrations of ancient surgery from this website.

Shutterstock — <https://www.shutterstock.com/home>

I used this website for generic photos of plants and historic sites.

CNN — <https://www.cnn.com>

I used this website to find pictures of herbal remedies.

Massachusetts General Hospital — <https://www.massgeneral.org>

*I used this website to gather some firsthand illustrations of Dr. Morton's
Demonstration.*

Anaesthesia Heritage Centre

*I took photos of primary artifacts, such as Dr. Morton's Ether Inhaler, during my visit
to the Heritage Centre.*

British Journal of Anaesthesia — <http://anaesthesiaheritagecentre.org>

I used this website to get more pictures of Dr. John Glen, the discoverer of propofol.

Educational Technology University of South Florida —

<https://www.usf.edu/education/areas-of-study/instructional-technology/>

I gathered more photos of anesthetic plants from this website.

Our Parkinson's Place — <http://ourparkinsonsplace.blogspot.com>

I used this website to get pictures of the contributors to the discovery of anesthesia.

Center for the History of Medicine — <https://countway.harvard.edu/center-history-medicine>

I gathered more historical illustrations from this website.

Science Museum — <https://www.sciencemuseum.org.uk>

*I collected more historical illustrations and portraits of Doctor Morton's
demonstration.*

BBC — <https://www.bbc.com>

I used this website to gather more images of plants.

Journal of Physiology — <https://physoc.onlinelibrary.wiley.com/journal/14697793>

I gathered historical documents from this website.

New Georgia Encyclopedia — <https://www.georgiaencyclopedia.org>

I used this website for pictures of equipment.

Lasker Foundation — <http://www.laskerfoundation.org>

I used this website to find more photos of Dr. Glen, since he won the Lasker-DeBakey Award in 2018.

The Countway Library of Medicine — <https://countway.harvard.edu>

I found many portraits of Dr. Morton, Dr. Wells, and Dr. Long on this website.

Utopian Surgery — <https://www.general-anaesthesia.com>

I used this website for more pictures and portraits of the surgeons and doctors.

Prado Museum — <https://www.museodelprado.es/en/the-collection>

I gathered more images of equipment and devices for this website.

Morgan Library and Museum — <https://www.themorgan.org>

I gathered historical documents and portraits off of this website.

Aurum Project — <https://aurumproject.org.au/#!/directory/map>

From this source, I collected generic photos of anesthetized patients.

Cell — <https://www.cell.com>

This website had more photos of Dr. Glen, so I gathered them.

Harvard University Library — <https://library.harvard.edu>

I used this website to get more images of institutions and hospitals, such as Mass General.

Louvre — <https://www.louvre.fr/en>

From this website I gathered more portraits of doctors and professors.

Wood Library Museum of Anesthesiology — <https://www.woodlibrarymuseum.org>

This website allowed me to gather many pictures of primary artifacts used throughout the development of anesthesia.

Medical Portrait Gallery — <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5590334/>

Using this website, I gathered more pictures of equipment.

Providence Regional Medical Center - Everett

I took pictures of the operating room at this hospital.

Art UK — <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5590334/>

From this website, I collected historical scenes of Dr. Morton's demonstration.

Wuhan Darppon Medical Technology Co., Ltd — <https://www.darppon.com>

I used this website to get a picture of the ventilator machine, which is now running low in stock, and therefore trying to be supplemented with a modified anesthesia machine.

NPR — <https://www.npr.org>

I gathered some CGI pictures of coronavirus from this website.

Consumer Reports — <https://www.consumerreports.org/cro/index.htm>

I used this website to gather more images of coronavirus.

ABC News — <https://abcnews.go.com>

From this website, I collected pictures of patients with the coronavirus who had difficulty breathing by themselves, hence requiring either a ventilator or a modified anesthesia machine to aid them.

Getty Images — <https://www.gettyimages.com>

I used this website to get pictures to symbolize opioids and their effect on the people of the US.

Blue Delaware — <https://bludelaware.com>

From this website, I took some images of what opioid addiction looks like.

Purdue University — <https://www.purdue.edu>

I used this website to gather more images of what opioid addiction looks like.

Johns Hopkins Medicine — <https://www.hopkinsmedicine.org>

I collected some pictures of what opioid addiction looks like from this website.

WUSF News — https://www.wusf.org/?_ga=2.250842949.2108142812.1586579943-1227019159.1583591225

This website gave me a picture of bottles of orally taken opioids, which I used to represent overdose.

Utopia Wellness — <https://utopiawellness.com>

From this website, I collected a few pictures of IV's, which were to be used to administer opioids intravenously.

Music list

“No Such Thing” – John Mayer

This fits the theme of thinking beyond the accepted. Since this year's theme is breaking barriers, an introduction song resonating that theme is suitable.

“Under a Phrygian Sky” – Loreena McKennitt

This song includes Arabic instruments and has an ancient style to it. Because it has these old elements, it is played when the primitive methods of early anesthesia are being described.

“Transformation” – Frank Wildhorn

This song is originally from the musical "Jekyll & Hyde." In the musical, Dr. Henry Jekyll, the protagonist, transforms into the monstrous villain, Edward Hyde. Right before the transformation, Jekyll is singing, but then screams in agony at the pain of the metamorphosis. I accentuated this part of the song to represent the sheer torture patients experienced without the existence of anesthesia.

"Mass" – Frank Wildhorn

This song is also from the musical "Jekyll & Hyde." It is a dramatic, dark piece, and I thought it would be suitable to play while describing the tragedy of the days without anesthesia.

“Piano Trio in E flat major, Op. 1, No. 1 I. Allegro – Beethoven

This song is from the classical/romantic era, the time of Morton. I chose this song as thinking background music.

“Numb” – Max Jury

This song is about the feeling of being numb. Anesthetics are supposed to induce unconsciousness as well as amnesia, so I thought this song would be perfect to play.

“Comfortably Numb” – Pink Floyd

This song, like previous one, describes numbness, and therefore fits with the topic of anesthesia.

“Touch the Sky” – Julie Fowlis

This song is an uplifting song, and basically says "the sky is the limit." It therefore fits with this year's theme of breaking barriers.

“Darkness in the City” – Mazm

This song is downcast, and a little bit eerie. Because the opioid epidemic is a melancholy topic, as well as a threatening crisis to many people, I thought this song would be suitable to play.

“Only Void Remains” – Mazm

This song is one of the more lighthearted ones, and gives off the feeling of hope in the tragedy, and therefore I think that it is a good one to play as the future of anesthesia is being described.