Essential Question: 7, 9, 13, 15 October 2020

How did the Wright brothers go about designing their devices?

How were they affected by their personal lives and the world around them?

Questions/Key Points	Notes
How were the Wright brothers raised, and how did their early life lead them to become interested in flight?	● Biographical info[2] ○ Wilbur - Born 1867 in Indiana, died 1912 in Dayton ○ Orville - Born 1871 in Dayton, died 1948 in Dayton ○ Father was a minister ○ Had a sister, Katharine who ended up helping her brothers ○ Were encouraged in their household "to pursue intellectual interests; to investigate whatever aroused curiosity" ○ Wilbur and Orville never got married nor went to college ○ Wilbur and orville began as newspaper printers, then went on to open a bicycle shop, providing funds to be used towards aeronautical research
The Wright brothers were interested in flight from a young age, but what caused them to begin experimenting with it? Was it an accident?	● Influences/research (article) ○ Were inspired initially upon receiving a helicopter toy from their father [2,3] ○ In 1896 Orville was bedridden with Typhoid fever ■ Wilbur heard of Otto Lilienthal's death and talked about it with Orville, while he was in bed ○ "I have been interested in the problem of mechanical and human flight ever since as a boy I constructed a number of bats of various sizes after the style of Cayley's and Penaud's machines. My observations since have only convinced me more firmly that human flight is possible and practicable...I wish to obtain such papers as the Smithsonian Institution has published on this subject, and if possible a list of other works in print in the English language" -Wilbur [5] ○ Wright brothers were much younger than those who had previously attempted to fly ○ Were inspired by Lilienthal as well as Louis Pierre Mouillard ■ "It was not till the news of the sad death of Lilienthal reached America in the summer of 1896 that we again gave more than passing attention to the subject of flying. We then studied with great interest Chanute's "Progress in Flying Machines," Langley's "Experiments in Aerodynamics," the "Aeronautical Annuals" of 1905, 1906, and 1907, and several pamphlets published by the Smithsonian Institution, especially articles by Lilienthal and extracts from Mouillard's "Empire of the Air." The larger works gave us a good understanding of the nature of the flying problem, and the difficulties in past attempts to solve it, while Mouillard and Lilienthal, the great missionaries of the flying cause, infected us with their own unquenchable enthusiasm, and transformed idle curiosity into the active zeal of workers" [11] ○ In close contact with Octave Chanute[1] ■ "Yet scientific aid he and his brother certainly received from the late Octave Chanute, that noble-minded pioneer who gave so generously out of his ripe experience...it was he who watched their initial experiments, and he who vouched for their success at a time when the world was still in doubt" [7] ■ First letter to him May 13, 1900, Chanute wrote back [8,9] ● "Dear Sir: For some years I have been afflicted with the belief that flight is possible to man" ■ Chanute met them in person in 1901 in Dayton, then witnessed some flights later [12, pg 48] ● "In the summer of 1901 we became personally acquainted with Mr. Chanute.

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If they had not done any research into other aviators, would they have figured out their method of control purely through experimentation? How did the Wright Brothers transition from gliders to powered airplanes?	When he learned that we were interested in flying as a sport, and not with any expectation of recovering the money we were expending on it, he gave us much encouragement. At our invitation, he spent several weeks with us at our camp at Kill Devil Hill, four miles south of Kitty Hawk, during our experiments of that and the two succeeding years. He also witnessed one flight of the power machine near Dayton, Ohio, in October, 1904" [11] ○ Kept a meticulously detailed record of their work[1] ○ "We had taken up aeronautics merely as a sport. We reluctantly entered upon the scientific side of it"[11] ■ Different approach than some of the other scientists studied ● Controlled flight [4] ○ Learned of Otto Lilienthal and how he shifted his weight around to control his glider ○ Decided that it needed a more dynamic approach; discovered wing warping by twisting a cardboard box ○ "Lilienthal and Chanute had guided and balanced their machines, by shifting the weight of the operator's body. But this method seemed to us incapable of expansion to meet large conditions, because the weight to be moved and the distance of possible motion were limited, while the disturbing forces steadily increased, both with wing area and with wind velocity...This could easily be done by using wings capable of being warped, and by supplementary adjustable surfaces in the shape of rudders...A happy device was discovered whereby the apparently rigid system of superposed surfaces, invented by Wenham, and improved by Stringfellow and Chanute, could be warped in a most unexpected way, so that the aeroplanes could be presented on the right and left sides at different angles to the wind. This, with an adjustable, horizontal front rudder, formed the main feature of our first glider" [11] ○ Encountered issues with adverse yaw and stalling on one side of the wing; figured out that they needed to use rudder as well as wing warps ■ Essentially discovered coordinated turning ■ "It was some time before a remedy was discovered. This consisted of movable rudders working in conjunction with the twisting of the wings" [11] ● Gliders ○ Built first glider in 1899, was semi-successful and the wing warps worked in control ○ Wilbur and Orville go to Kitty Hawk in 1900 and begin flying in October ■ Were again semi-successful; flew gliders but did not fly for long ○ Built larger gliders in 1901 and found more success; distances reached almost 400 ft [6a] ○ Throughout their research, Wilbur and Orville go back and forth between Kitty Hawk and Dayton ○ Usually tested their gliders by flying them like kites, manned or unmanned ● Data collection ○ Took extensive pictures, detailed notes, wrote many letters to family members ○ Did not intend to take a scientific approach at first but realized that they had to do it if they were to be successful ● Powered flight, engines ○ End of 1902 - began building airplane with 4 propellers; file for patent in March 1903 https://pdfpiw.uspto.gov/.piw?Docid=00821393 ○ "Our tables made the designing of the wings an easy matter, and as screw-propellers are simply wings traveling in a spiral course, we anticipated no trouble from this source. We had thought of getting the

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Were the Wright Brothers really successful on their first flight? After all, they had to launch it down a track and fly in strong winds. Why were the Wright Brothers so secretive of their work when everyone else was very public about it? To what extent did that contribute to the skepticism they faced? Were the Wright Brothers justified in getting involved with so many patent suits?	theory of the screw-propeller from the marine engineers, and then, by applying our tables of air-pressures to their formulas, of designing air-propellers suitable for our purpose. But so far as we could learn, the marine engineers possessed only empirical formulas, and the exact action of the screw-propeller, after a century of use, was still very obscure. As we were not in a position to undertake a long series of practical experiments to discover a propeller suitable for our machine, it seemed necessary to obtain such a thorough understanding of the theory of its reactions as would enable us to design them from calculations alone. What at first seemed a problem became more complex the longer we studied it. With the machine moving forward, the air flying backward, the propellers turning sidewise, and nothing standing still, it seemed impossible to find a starting-point from which to trace the various simultaneous reactions. Contemplation of it was confusing. After long arguments we often found ourselves in the ludicrous position of each having been converted to the other's side, with no more agreement than when the discussion began" [11] ■ Found particular difficulty in designing a propeller since nobody really understood how they worked and the calculations regarding those. ○ 1903, Dec. 14th, try to fly with powered airplane but were unsuccessful. [13] ■ "The wind was only about 5 miles an hour so we anticipated difficulty in getting speed enough on our short track (60 ft) to lift" ■ Stalled the aircraft and it did not make it very far ■ "the power is ample, and but for a trifling ever due to lack of experience with this machine and this method of starting, the machine would undoubtedly have flown beautifully" ○ 1903 Dec 17th, are successful. ■ "This flight lasted only 12 seconds, but it was nevertheless the first in the history of the world in which a machine carrying a man had raised itself by its own power into the air in full flight, had sailed forward without reduction of speed, and had finally landed at a point as high as that from which it started" - Orville [11] ○ After they made their first flight, continued working on their planes until they could fly sustainably in circles ○ Became involved with the military and tried to secure a contract with them for funding if they could demonstrate the capabilities of their aircraft ○ Used a monorail track to assist in takeoffs, also sometimes used catapults and derricks. Had to take off into the wind to generate enough lift. [18] ○ Sept. 1908; Orville is seriously injured and Lt. Thomas Selfridge dies in a crash after a prop breaks [15] ● Skepticism ○ Did not publicly fly or display airplane until they had received a contract and a patent ■ Very possessive of their intellectual property ○ Period of skepticism was largely because they were so secretive, and because other people had falsely claimed that they had been successful ○ Flew in France in 1908 and skepticism disappeared. ● Patent war ○ Record of photographs helped them to fight when trying to patent their control method[1] ○ August 1909 - Wrights sue Glenn Curtiss because he sold an airplane to the Aeronautic Society of New York ○ Continue fighting in patent lawsuits and court battles through April 1912 [6a] ○ Causes Octave Chanute to become upset with them

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Do the Wright Brothers deserve as much credit as they get? (article)	■ Publicly disapproves of their dealings, ends their friendship. ■ Wilbur Wright ends up delivering his Eulogy at his funeral [see 1.4] ● Flight school [18] ○ Opened the Wright Brothers Flying School in Montgomery, Alabama in 1910 ○ Intended as a way for them to generate awareness for people to buy their airplanes since they were facing competition ○ Flight school only lasted for about a month ○ Represents the first civilian flight school in America ● Death and legacy ○ Collections of their notes are now at the Library of Congress and Wright State University. [1] ○ Wilbur dies on May 30th, 1912 of Typhoid fever [17] ○ Orville - 1915, sells his share of the Wright Company; 1916, left the bike shop and helped with various aviation projects. Died in 1948 of a heart attack ○ 1932, Kill Devil Hills dedicated as a memorial to the Wright Brothers by Herbert Hoover[20] ■ Wright Brothers National Memorial is still in Kitty Hawk, alongside First Flight Airport (general aviation) ● Other fun things ○ "We have been living fine since you left. Orville cooks one week and I cook the next. Orville's week we have bread and butter and meat and gravy and coffee three times a day. My week I give him more variety. You see that by the end of his week there is a big lot of cold meat stored up, so the first half of my week we have bread and butter and "hash" and coffee, and the last half we have bread and butter and eggs and sweet potatoes and coffee. We don't fuss a bit about whose week it is to cook. Perhaps the reason is evident. If Mrs. Jack Sprat had undertaken to cook all fat, I guess Jack wouldn't have kicked on cooking every other week either" (letter from Wilbur to Katharine) ○ Recent license plate battle between Ohio and North Carolina - NC has "first in flight" on their license plates (b/c Kitty Hawk) but Ohio has "Birthplace of aviation" on their license plates. [16] References 1. https://www.jstor.org/stable/44525294 - article about Wright Brothers collection of materials at Wright State and LOC 2. https://www.britannica.com/biography/Wright-brothers 3. https://www.nps.gov/wrbr/learn/historyculture/theroadtothefirstflight.htm 4. McCullough, David. *The Wright Brothers*. United Kingdom: Simon & Schuster, 2015. 5. https://siarchives.si.edu/history/featured-topics/stories/letter-dated-may-30-1899 - letter from Wilbur to the Smithsonian requesitng materials about flight 6. LOC: *Wilbur and Orville Wright Papers at the Library of Congress* https://www.loc.gov/collections/wilbur-and-orville-wright-papers/about-this-collection/ a. https://www.loc.gov/collections/wilbur-and-orville-wright-papers/articles-and-essays/the-wilbur-and-orville-wright-timeline-1846-to-1948/ - Timeline of the Wright Brothers 7. https://www.jstor.org/stable/26010730 - tribute to Wilbur in *Scientific American* after his death 8. https://www.loc.gov/resource/mwright.06001/?sp=1 - first letter from Wilbur to

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Summary

The Wright brothers are well known for their contributions to aviation and their success in powered flight. From a young age, they were fascinated with flight after receiving a toy helicopter from their father. They were raised in a household that encouraged questioning and exploration of new ideas. Upon hearing of Otto Lilienthal's death, they became involved in aviation and began their work. Although most people have positive notions of the Wright Brothers, most are unaware of their engagement in some questionable activities, such as their patent wars, and perhaps get more credit than they deserve.