Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/26

Letter of Reflection

Final Portfolio

Dear Reader,

The following portfolio represent my cumulative work over the past semester in the wonderful writing seminar "Leonardo: Scientist and Artist" instructed by Professor Jo Caplin. The central theme of the course was exploring the intimate connection between the artistic works of Renaissance painter Leonardo da Vinci and his scientific research. By learning more about his life and history in the cultural centre of Florence and surrounding areas, a better understanding of Leonardo's unique way of thinking and the profile that classifies him as a "Renaissance man" can be constructed.

As an engineer, I focused mostly on Leonardo's studies into the physical world and (potential) contributions to mechanical design. My research sequence focuses on the view of Leonardo as a founder of modern science, particularly in the field of aeronautics, the science of flight. To support my arguments, I looked through various texts written by Leonardo scholars including Martin Kemp of University of Oxford, Ivor B. Hart of University of London, and Italian historian Domenico Laurenza. In addition, I had the chance to read the original *Codex Atlanticus* in its original form through the "Codice Atlantico" software from the Leonardo3 project. Being able to view a copy of the primary source first-hand allowed me to gain a deeper insight into Leonardo's mind and thus be able to more clearly refine my viewpoints.

Due to course scheduling conflicts during my freshman year, I had to complete my writing seminar requirement this semester during my sophomore year. Majoring in computer engineering, this is the first course that I have taken so far at UPenn requiring me to write so frequently. Over the course of the semester, I have noticed improvement in my writing style and research techniques thanks to this writing seminar. As the topic also encompassed a field of interest, I was also able to enjoy the content of the course throughout. In addition, the research sequence gave me my first chance to properly visit the Van Pelt Library. I was fascinated by the endless shelves of resources on just about any subject imaginable. With such a plethora of knowledge available to me, I was strongly inspired to read and learn more about Leonardo.

Sincerely,

Philip Peng

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/14

Judgmental Synthesis Draft 2 of 2 (Final)

Final Portfolio

Father of Flight

In his book *The Mechanical Investigations of Leonardo da Vinci*, Ivor B. Hart of University of London asks the question, "Suppose Leonardo had written a treatise on mechanics… How far would it have been an original contribution to the knowledge of the day, and to the development of the future?" (Hart 12). For Renaissance artist and scientist Leonardo da Vinci (1452-1519), the answer to that question would have undoubtly lain alongside Leonardo's own answer to the centuries-long dream of flight. As Hart meticulously describes, "da Vinci was not only a real pioneer of the science of flight, but was also the first pioneer" (Hart 146). Famous aviators such as the Wright brothers Orville and Wilbur brought the dream of flying to the world's attention when they achieved the first sustained motor-driven, man-carrying flight in 1903, but they were not the first to enter the field of aeronautics, the science of flight. Centuries earlier, Leonardo had mastered not only the theory but also the design. Unfortunately, his notes, nowadays referred to as his *Notebooks*, were never published during his time. Had his research into flight been published and revealed to the world, Leonardo would have become the father of modern aeronautics.

With his flight theories described in his *Notebooks*, Leonardo may have been the father of aerodynamics, the physical science of flight. Leonardo sought to understand the natural process of flight through the power of observation and investigation. In *Manuscript E*, Leonardo wrote, "to give true science to the movement of birds in air, it is necessary to study the science of the winds" (Laurenza 94). To understand what made flight possible, Leonardo believed that he must first study and derive the physical laws of nature governing air. In *Codex Atlanticus*, Leonardo wrote, "See how the wings, striking against the air, sustain the heavy eagle in the thin air on high… As much force is exerted by the object against the air as by the air against the object" (Capra 185). Through his studies of eagle wings, Leonardo was able to attribute lift, the upward force that allows for flight, to what became known two hundred years later as Newton's third law of motion. Lift was not the only basic law of aerodynamics that Leonardo discovered, however. In his *Codex "On the Flight of Birds"*, Leonardo observed the fluid-like compression of air induced by the beating wings of birds. The high pressure difference created by the cone-shaped wedge of air underneath the bird's wings generates thrust, the force that allows flying objects to maintain forward motion. Leonardo had attributed thrust to Bernoulli's Principle almost three

hundred years before the principle was stated by Daniel Bernoulli. Aside from pure observations, Leonardo also built pulley machines that suspended dead birds from strings, explaining, "this is done to find the centre of gravity of the bird" (Hart 153). In a time before Newtonian physics, Leonardo recognized the role of gravity in maintaining balance and control of flight, writing, "the heavier portion always guides the movement" (Hart 155). Through his studies of birds, nature's perfected flying machines, Leonardo was able to derive numerous physical laws and theories used in aerodynamics even today.

Aerodynamics was not the only part of aeronautics that Leonardo pioneered. Had he published the flying machine designs in his *Notebooks*, Leonardo may have been the father of aviation, the field of design of flight-capable machines. Many of his conceptual designs found scattered among his notes can be considered primitive prototypes of modern aircrafts and their components. In the lower portion of folio 64r of *Madrid I Manuscript* lays a sketch of a kite with cables allowing for steering. Inventors of the Quattrocento era that came before the Renaissance had already experimented with parachutes, but Leonardo's sketch was the first of its kind that integrated directional control akin to navigational mechanisms used in gliders today. In another design on folio 83v in *Manuscript B*, Leonardo sketched out and described an "aerial screw" design that "bores" into air with enough velocity to move upward. Such a design can be seen as the preceder of modern day jet engine turbines used to propel airplanes forward. In his study of birds, Leonardo noted the role of the tail feathers and the alula – small tuft of small stiff feathers on the first digit of a bird's wing – in maintaining maneuverability and equilibrium. Leonardo then went on to modify later flying machine designs in *Codex Atlanticus* to include similar appendages. The importance of these two additions have always been acknowledged thereafter, being manifested as the tail wings and slats on modern day airplanes. Despite living in a time where flying was still just a dream, Leonardo developed many sound mechanical designs used aeronautics even today.

Throughout his life, Leonardo pioneered both the science and engineering of flight. Despite all his theory and design ideas, he was never able to implement any of them properly due to lack of materials and technology during the Renaissance. Had Leonardo been given access to the resources he wished for, however, the world of aeronautics would be far more advanced today. In recent years, British engineers have built a glider based on one of Leonardo's designs in his notebook. Made of modern day, durable and lightweight material, the "Leonardo glider" not only survived its initial flight down the chalky Sussex Downs cliff in southeastern England but also reportedly exceeded the history-making first attempts by the Wright brothers in 1903. If Leonardo had the resources to exceed a feat four hundred years into the future, who knows how far ahead the world of aerospace would be today. In a century where the sky is no longer the limit, discovering Leonardo just may have been the key to flying to Mars.

Works Cited/Consulted

Bell, Dana. *Smithsonian atlas of world aviation: charting the history of flight from the first balloons to today's most advanced aircraft*. New York: Harper Collins, 2008. Print.

Capra, Fritjof. *The Science of Leonardo*. New York: Anchor Books, 2008. Print.

Kemp, Martin. *Leonardo*. New York: Oxford University Press, 2004. Print.

Hart, Ivor B. *The Mechanical Investigations of Leonardo da Vinci*. California: University of California Press, 1963. Print.

Laurenza, Domenico. *Leonardo on Flight*. Baltimore: The Johns Hopkins University Press, 2004. Print.

Scott, Phil. *The pioneers of flight: a documentary history*. New Jersey: Princeton University Press, 1999. Print.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/14

Final Portfolio

Descriptive Outline of Judgmental Synthesis Draft 2 of 2 (final)

Proposition: Had Leonardo revealed his research into flight to the world, he would have become the father of modern aeronautics

Plan: To write a judgmental synthesis as a Leonardo scholar.

Paragraph 1:

Says: Had Leonardo revealed his research into flight to the world, he would have become the father of modern aeronautics.

Does: Sentence 1 quotes a Leonardo scholar posing a theoretical question. Sentence 2 answers the question and introduces Leonardo. Sentence 3 clarifies the answer with a quote. Sentence 4 references a relevant historical event. Sentence 5 presents two reasons supporting the proposition. Sentence 6 states a fact that explains why the proposition would only be a theoretical answer. Sentence 7 states the proposition.

Paragraph 2:

Says: Had he decided to publish his theories described in his Notebooks, Leonardo may have been the father of aerodynamics, the physical science of flight.

Does: Sentence 1 states the first reason supporting the proposition. Sentence 2 explains why Leonardo studied flight. Sentence 3 gives a quote supporting that explanation. Sentence 4 explains the quote. Sentence 5 gives a quote from the Codex. Sentence 6 explains the quote and relates it to the reason. Sentences 7-8 give an example observation by Leonardo. Sentences 9-10 explain the observation and relate it to the reason. Sentence 9 gives an example of studying physical birds. Sentence 10 explains the significance of it and relates it to the reason. Sentence 10 concludes the paragraph.

Paragraph 3:

Says: Had he decided to publish his flying machine designs in his Notebooks, Leonardo may have been the father of aviation, the field of design of flight-capable machines.

Does: Sentences 1-2 state the second reason supporting the proposition. Sentence 3 describes Leonardo's designs. Sentence 4 gives an example supporting the reason. Sentence 5 explains the example. Sentence 6 gives another example. Sentence 7 explains the example. Sentence 8 gives a third example. Sentence 9 explains the example. Sentence 10 concludes the paragraph.

Paragraph 4:

Says: If Leonardo had been given the opportunity to complete such a historical flight in his time, the world of aeronautics would have started many centuries in advance

Does: Sentence 1 restates the proposition. Sentence 2 states a problem. Sentence 3 hypothesizes what would have happened if there was no problem. Sentences 4-5 give a modern-day-example Sentence 6 explains the example. Sentence 7 makes a prediction.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/14

Judgmental Synthesis Draft 1 of 2

Final Portfolio

Father of the Air

In *The Mechanical Investigations of Leonardo da Vinci* by Ivor B. Hart of University of London about Renaissance artist and scientist Leonardo da Vinci, Hart asks the question, "Suppose Leonardo had written a treatise on mechanics… How far would it have been an original contribution to the knowledge of the day, and to the development of the future?" (Hart 12). The answer given in Hart's book, Italian historian Domenico Laurenza's book *Leonardo on Flight*, University of Oxford professor Martin Kemp's book *Leonardo*, and physicist Fritjof Capra's book *The Science of Leonardo*, is, as Hart describes it, "da Vinci was not only a real pioneer of the science of flight, but was also the first pioneer" (Hart 146). Famous aviators such as the Wright brothers, Orville and Wilbur, brought the dream of flying to the world's attention when they achieved the first sustained motor-driven, man carrying flight in 1903, but they were not the first to enter the field of aeronautics, the science of flight. Had Leonardo revealed his research into flight to the world, he would have become the father of modern aeronautics.

Had he decided to publish his theories described in his Notebooks, Leonardo may have been the father of aerodynamics, the physical science of flight. As explained by Ernest A Moody from University of California, Los Angeles, "Leonardo, unlike his scholastic predecessors, did not take up physical problems merely for the sake of displaying logical or mathematical skill; he sought the help of mathematics because he wanted to lay bare the structure of natural processes, and to discover the truth of things." (Hart X). Concerning the natural process of flight, Leonardo wrote in *Manuscript E*, "To give true science *to* the movement of birds in air, it is necessary to study the science of the winds" (Laurenza 94). Leonardo studied and derived physical laws of nature in order to understand how they made flight possible. In *Codex Atlanticus*, Leonardo wrote, "See how the wings, striking against the air, sustain the heavy eagle in the thin air on high… As much force is exerted by the object against the air as by the air against the object" (Capra 185). Through his studies of eagle wings, Leonardo was able to attribute lift, the upward force that allows for flight, to Newton's third law of motion two hundred years before Newton's birth. Lift was not the only basic law of aerodynamics that Leonardo discovered, however; in *Codex On the Flight of Birds*, Leonardo observed how the propulsion beat of bird wings condenses air in a fluid-like manner. Through compression of the air underneath the bird's wings, a cone-shaped wedge of higher pressure is created, generating thrust, the force that allows

flying objects to maintain forward motion. Leonardo had attributed thrust to Bernoulli's Principle, a fluid dynamics principle stated by Daniel Bernoulli almost three hundred years after Leonardo's wrote the codex. Aside from pure observations, Leonardo also built pulley machines that suspended dead birds from strings, explaining, "this is done to find the centre of gravity of the bird" (Hart 153). In a time before Newtonian physics, Leonardo recognized the role of gravity in maintaining balance and control of flight, writing, "the heavier portion always guides the movement" (Hart 155). Through his studies of birds, nature's perfected flying machines, Leonardo was able to derive numerous physical laws and concepts used in aerodynamics even today.

Aerodynamics was not the only part of aeronautics that Leonardo pioneered. Had he decided to publish his flying machine designs in his Notebooks, Leonardo may have been the father of aviation, the field of design of flight-capable machines. In the lower portion of *Madrid I Manuscript* folio 64r lays a sketch of a kite with cables allowing for steering. Parachutes had already been speculated on by inventors of the Quattrocento era but this was the first of its kind that integrated directional control, akin to modern gliders of today. In another design on folio 83v in *Manuscript B*, Leonardo sketches out and describes as "aerial screw" design that "bores" into air with a quick enough velocity to move upward. Such a design was the preceder of propellers in modern day jet engines used to propel airplanes forward. In his study of birds, Leonardo also noted the role of the tail feathers and the alula – small tuft of small stiff feathers on the first digit of a bird's wing – in maintaining maneuverability and equilibrium, and modified later designs in *Codex Atlanticus* accordingly. These additions are manifested as the tail wings and slats on modern day airplanes. Despite living in a time where flying was still just a dream, Leonardo developed many sound mechanical designs used aeronautics even today.

Throughout his life, Leonardo pioneered both the science and engineering of flight. Despite all his theory and design ideas, he was never able to implement any of them properly due to lack of materials and technology during the Renaissance. In recent years, however, British engineers have built a glider based on one of Leonardo's designs in his notebook. Made of modern day, durable and lightweight material, the "Leonardo glider" not only survived its initial flight down the chalky Sussex Downs cliff in southeastern England but also reportedly exceeded the history-making first attempts by the Wright brothers in 1903. If Leonardo had been given the opportunity to complete such a historical flight in his time, the world of aeronautics would have started many centuries in advance. Today, we have even successfully flown astronauts to Mars.

Works Cited/Consulted

Bell, Dana. *Smithsonian atlas of world aviation: charting the history of flight from the first balloons to today's most advanced aircraft*. New York: Harper Collins, 2008. Print.

Capra, Fritjof. *The Science of Leonardo*. New York: Anchor Books, 2008. Print.

Kemp, Martin. *Leonardo*. New York: Oxford University Press, 2004. Print.

Hart, Ivor B. *The Mechanical Investigations of Leonardo da Vinci*. California: University of California Press, 1963. Print.

Laurenza, Domenico. *Leonardo on Flight*. Baltimore: The Johns Hopkins University Press, 2004. Print.

Scott, Phil. *The pioneers of flight: a documentary history*. New Jersey: Princeton University Press, 1999. Print.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/14

Final Portfolio

Descriptive Outline of Judgmental Synthesis Draft 1 of 2

Proposition: Had Leonardo revealed his research into flight to the world, he would have become the father of modern aeronautics

Plan: To write a judgmental synthesis as a Leonardo scholar.

Paragraph 1:

Says: Had Leonardo revealed his research into flight to the world, he would have become the father of modern aeronautics.

Does: Sentence 1 quotes a Leonardo scholar posing a theoretical question. Sentence 2 answers with a quote. Sentence 3 states a historical fact and its relation to the question. Sentence 4 states the proposition.

Paragraph 2:

Says: Had he decided to publish his theories described in his Notebooks, Leonardo may have been the father of aerodynamics, the physical science of flight.

Does: Sentence 1 states the first reason supporting the proposition. Sentence 2 gives a quote explains why Leonardo studied flight. Sentence 3 gives a quote supporting that explanation. Sentence 4 explains the quote. Sentence 5 gives a quote from the Codex. Sentence 6 explains the quote and relates it to the reason. Sentences 7-8 give an example observation by Leonardo. Sentences 9-10 explain the observation and relate it to the reason. Sentence 9 gives an example of studying physical birds. Sentence 10 explains the significance of it and relates it to the reason. Sentence 10 concludes the paragraph.

Paragraph 3:

Says: Had he decided to publish his flying machine designs in his Notebooks, Leonardo may have been the father of aviation, the field of design of flight-capable machines.

Does: Sentences 1-2 state the second reason supporting the proposition. Sentence 3 describes Leonardo's designs. Sentence 4 gives an example supporting the reason. Sentence 5 explains the example. Sentence 6 gives another example. Sentence 7 explains the example. Sentence 8 gives a third example. Sentence 9 explains the example. Sentence 10 concludes the paragraph.

Paragraph 4:

Says: If Leonardo had been given the opportunity to complete such a historical flight in his time, the world of aeronautics would have started many centuries in advance

Does: Sentence 1 restates the proposition. Sentence 2 states a problem. Sentences 3-4 give a modern-day-example. Sentence 5 hypothesizes what would have happened if there was no problem. Sentence 7 makes a prediction.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/12

Complex Synthesis Draft 3 of 3 (Final)

Final Portfolio

Pursuing the Dream of Flight

In December, 1903, the Wright brothers, Orville and Wilbur, achieved the first controlled motor-driven, man carrying flight. Their prototype aerocraft's remarkable feat ended mankind's centuries-long dream of flying and gave birth to a new era of aviation. The Wright brothers, however, were not the first to so rigorously pursue such a dream. In his book *The Science of Leonardo*, Fritjof Capra introduces the reader to Leonardo da Vinci, a Renaissance artist and scientist who dedicated much of his life on research in aerodynamics, a field almost non-existent during his time. Capra and the sources he cites all indicate that Leonardo not only meticulously studied the flight patterns of birds but also applied his knowledge of mechanics into designing various "flying machines". In the eyes of Capra and cited Leonardo scholars, including Ivor B. Hart of University of London, Italian historian Domenico Laurenza and professor Martin Kemp of University of Oxford, Leonardo was a pioneer of the science of flight.

According to historical studies by Leonardo scholars, Leonardo studied flight by observing the best source available to him: nature. In Laurenza's book *Leonardo on Flight,* he describes Leonardo's studies into the flight patterns of birds which were recorded dutifully in Notebooks, most notably Codex *Sul volo degli uccelli* ("On the Flight of Birds") and Codex *Atlanticus*. According to Hart's provided translations of Codex Atlanticus, folio 1058v, Leonardo writes, "you may see that the beating of its wings against the air supports a heavy eagle in the highest and rarest atmosphere… a man with wings large enough and duly connected might learn to overcome the resistance of the air" (Hart 150). Leonardo believed that through the study of heavy birds of prey such as the eagle, he could uncover enough of nature's secrets to be able to mimic natural flight. Leonardo detailingly studied the physical aerodynamics that allowed birds to stay airborne. In folios 18r to 16v of "On the Flight of Birds", Laurenza explains that Leonardo attributed the suspension to the cone-shaped cushion of condensed air formed by the lateral and twisting motions of bird wings. According to Phil Scott of Princeton University, such detailed observation is surprisingly accurate considering the lack of stop-action photography which was used in the nineteenth century to more carefully study the flapping motion of birds. This evidence led Capra to believe that Leonardo's studies into birds, nature's perfected flying machines, represented one of mankind's first scientific attempts in understanding the theory of flight.

While Capra naturalistic research helped Leonardo understand flight, mechanical designs were needed to achieve it. Scholars argue that Leonardo's mechanical flying machine designs represent the early beginnings of aerocrafts in modern aviation. Thirteenth century philosopher Roger Bacon once envisioned, "an instrument may be made to fly… by which the wings, being artificially composed, may beat the air after the manner of a flying bird" (Hart 145). Hart believed that this vision served as a starting point for Leonardo as some of his early designs were mechanics that tried to mimic nature. In Codex Atlanticus, folio 1051v, Leonardo sketched out a flying machine design composed of two human-powered sets of mechanical wings that imitate the alternating movement of the double pair of dragonfly wings; Laurenza translates Leonardo's notes to "when part B goes up, part A has to go down, because there always has to be a part that is pressing down on air" (Laurenza 20). Referring to Leonardo's famous bat-like flapping glider design or "Leonardo's flying machine" detailed out in Codex Atlanticus folios 848r, 846v, 824v, and 70br and again in Manuscript B folios 75r and 74v, Laurenza points out Leonardo's pioneering experimentation with the idea of the pilot lying horizontally and steering by controlling movable wings. According to Leonardo scholar Martin Kemp, the "Leonardo's glider", was built and successfully tested in England, reportedly exceeding the first attempts of the Wright brothers (Kemp 127). While Leonardo was unsuccessful in his pursuits of the dream of flight, Capra's research convinced him that Leonardo's efforts represented one of mankind's first serious attempts at designing flying machines.

Works Cited/Consulted

Capra, Fritjof. *The Science of Leonardo*. New York: Anchor Books, 2008. Print.

Kemp, Martin. *Leonardo*. New York: Oxford University Press, 2004. Print.

Hart, Ivor B. *The Mechanical Investigations of Leonardo da Vinci*. California: University of California Press, 1963. Print.

Laurenza, Domenico. *Leonardo on Flight*. Baltimore: The Johns Hopkins University Press, 2004. Print.

Scott, Phil. *The pioneers of flight: a documentary history*. New Jersey: Princeton University Press, 1999. Print.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/12

Final Portfolio

Descriptive Outline of Complex Synthesis Draft 3 of 3 (Final)

Proposition: Leonardo was a pioneer of the science of flight.

Plan: To write a complex synthesis using research from various scholarly sources.

Paragraph 1:

Says: Scholars agree that Leonardo was a pioneer of the science of flight.

Does: Sentences 1-3 state a historical achievement in aviation. Sentence 4 describes Capra's book. Sentence 5 describes Capra and Leonardo scholars' opinions. Sentence 6 states the proposition.

Paragraph 2:

Says: Scholars agree that Leonardo studied flight by observing the best source available to him: nature.

Does: Sentence 1 states the first argument supporting the proposition. Sentence 2 states the names of relevant codices. Sentence 3 gives an example supporting the argument. Sentence 4 explains the example. Sentences 5-6 give another example supporting the argument. Sentence 7 explains the example. Sentence 8 concludes the paragraph.

Paragraph 3:

Says: Scholars agree that Leonardo's mechanical flying machine designs represent the early beginnings of aerocrafts in modern aviation

Does: Sentence 1 states the second argument supporting the proposition. Sentences 2-4 explain the origins of Leonardo's fascination. Sentences 5-6 give an example supporting the argument and explain it through a quote. Sentence 7 gives another example and explains it. Sentence 8 gives a third example and explains it. Sentence 9 concludes the paragraph.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/12

Complex Synthesis Draft 2 of 3

Final Portfolio

Pursuing the Dream of Flight

In December, 1903, the Wright brothers, Orville and Wilbur, achieved the first controlled motor-driven, man carrying flight. Their prototype aerocraft's remarkable feat ended mankind's centuries long dream of flying and gave birth to a new era of aviation. The Wright brothers, however, were not the first to so rigorously pursue such a dream. In his book *The Science of Leonardo*, Fritjof Capra introduces the reader to Leonardo da Vinci, a Renaissance artist and scientist who dedicated much of his life on research in aerodynamics, a field almost non-existent during his time. Capra and the sources he cites all indicate that Leonardo not only meticulously studied the flight patterns of birds but also applied his knowledge of mechanics into designing various "flying machines". In the eyes of Capra and cited Leonardo scholars, including Ivor B. Hart of University of London and Italian historian Domenico Laurenza, Leonardo was a pioneer of the science of flight.

According to historical records, Leonardo studied flight by observing the best source available to him: nature. In his book *Leonardo on Flight,* Laurenza describes Leonardo's studies into the flight patterns of birds which were recorded dutifully in Notebooks, most notably Codex *Sul volo degli uccelli* ("On the Flight of Birds") and Codex *Atlanticus*. According to Hart's provided translations of Codex Atlanticus, folio 1058v, Leonardo writes, "you may see that the beating of its wings against the air supports a heavy eagle in the highest and rarest atmosphere… a man with wings large enough and duly connected might learn to overcome the resistance of the air" (Hart 150). Leonardo believed that through the study of heavy birds of prey such as the eagle, he could uncover enough of nature's secrets to be able to mimic natural flight. Leonardo detailingly studied the physical aerodynamics that allowed birds to stay airborne. In folios 18r to 16v of "On the Flight of Birds", Laurenza explains that Leonardo attributed the suspension to the cone-shaped cushion of condensed air formed by the lateral and twisting motions of bird wings. According to Phil Scott of Princeton University, such detailed observation is surprisingly accurate considering the lack of stop-action photography which was used in the nineteenth century to more carefully study the flapping motion of birds. Leonardo's studies into birds, nature's perfected flying machines, represented one of mankind's first scientific attempts in understanding the theory of flight.

While naturalistic research helped Leonardo understand flight, mechanical designs were needed to achieve it. Scholars argue that Leonardo's mechanical flying machine designs represent the early beginnings of aerocrafts in modern aviation. Thirteenth century philosopher Roger Bacon once envisioned, "an instrument may be made to fly… by which the wings, being artificially composed, may beat the air after the manner of a flying bird" (Hart 145). Hart believed that this vision served as a starting point for Leonardo as some of his early designs tried to mimic mechanics found in nature. In Codex Atlanticus, folio 1051v, Leonardo sketched out a flying machine design composed of two human-powered sets of mechanical wings that imitate the alternating movement of the double pair of dragonfly wings. Laurenza translates Leonardo's notes to "when part B goes up, part A has to go down, because there always has to be a part that is pressing down on air" (Laurenza 20). For his folio 80r "flying machine formed like the domed hull of a ship, with a pilot standing in the centre and four flapping wings", as Laurenza describes it, Leonardo designs the machine such that all parts of the human body is used to maximize the force generated for lifting the "ornithopter" and the body itself up into the air (Laurenza 44). In his famous bat-like flapping glider design or "Leonardo's flying machine" detailed out in Codex Atlanticus folios 848r, 846v, 824v, and 70br and again in Manuscript B folios 75r and 74v, Laurenza points out Leonardo's pioneering experimentation with the idea of the pilot lying horizontally and steering by controlling movable wings. According to Leonardo scholar Martin Kemp, the "Leonardo's glider", was built and successfully tested in England, reportedly exceeding the first attempts of the Wright brothers (Kemp 127). While Leonardo was unsuccessful in his pursuits of the dream of flight, scholars agree that his efforts represented one of mankind's first serious attempts at designing flying machines.

Works Cited/Consulted

Capra, Fritjof. *The Science of Leonardo*. New York: Anchor Books, 2008. Print.

Kemp, Martin. *Leonardo*. New York: Oxford University Press, 2004. Print.

Hart, Ivor B. *The Mechanical Investigations of Leonardo da Vinci*. California: University of California Press, 1963. Print.

Laurenza, Domenico. *Leonardo on Flight*. Baltimore: The Johns Hopkins University Press, 2004. Print.

Scott, Phil. *The pioneers of flight: a documentary history*. New Jersey: Princeton University Press, 1999. Print.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/12

Final Portfolio

Descriptive Outline of Complex Synthesis Draft 2 of 3

Proposition: Leonardo was a pioneer of the science of flight.

Plan: To write a complex synthesis using research from various scholarly sources.

Paragraph 1:

Says: Scholars agree that Leonardo was a pioneer of the science of flight.

Does: Sentences 1-3 state a historical achievement in aviation. Sentence 4 describes Capra's book. Sentence 5 describes Capra and Leonardo scholars' opinions. Sentence 6 states the proposition.

Paragraph 2:

Says: Scholars agree that Leonardo studied flight by observing the best source available to him: nature.

Does: Sentence 1 states the first argument supporting the proposition. Sentence 2 states the names of relevant codices. Sentence 3 gives an example supporting the argument. Sentence 4 explains the example. Sentences 5-6 give another example supporting the argument. Sentence 7 explains the example. Sentence 8 concludes the paragraph.

Paragraph 3:

Says: Scholars agree that Leonardo's mechanical flying machine designs represent the early beginnings of aerocrafts in modern aviation

Does: Sentence 1 states the second argument supporting the proposition. Sentences 2-4 explain the origins of Leonardo's fascination. Sentences 5-6 give an example supporting the argument and explain it through a quote. Sentence 7 gives another example and explains it. Sentence 8 gives a third example and explains it. Sentence 9 concludes the paragraph.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/07

Complex Synthesis Draft 1 of 3

Final Portfolio

Pursuing the Dream of Flight

In December, 1903, the Wright brothers, Orville and Wilbur, achieved the first sustained motor-driven, man carrying flight. Their prototype aerocraft and remarkable feat ended mankind's centuries long dream of flying and gave birth to a new era of aviation. While the Wright brothers were undoubtly the first to achieve "heavier-than-air" flight, they were far from the first to pursue such a dream. One such person was Renaissance artist and scientist Leonardo da Vinci. In his book *The Science of Leonardo*, Fritjof Capra introduces the reader to the engineering side of Leonardo, including his deep research into flight. Leonardo dedicated much of his life on research in aerodynamics, a field almost non-existent during his time. Not only did he meticulously study the flight patterns of birds and other natural fliers, but he also applied his knowledge of mechanics into designing various "flying machines" that he hoped could accomplish something that had yet to be achieved in the fourteenth century. In Capra's eyes, nobody pursued the science of flight as diligently as Leonardo did. As Ivor B. Hart of University of London once put it, Leonardo was a pioneer of the science of flight.

As a true scientist, Leonardo studied flight by observing the best source available to him: nature. Winged dragons and other fantastical flying creatures were often subjects of Florentine art at the time and Leonardo was also a very passionate person when it came to the animal kingdom. When he returned to Florence in 1500, he spent long hours observing the many birds in the hills surrounding the city. His studies into the flight patterns of birds around him were recorded dutifully in his Notebooks, most notably Codex *Sul volo degli uccelli* ("On the Flight of Birds") and Codex *Atlanticus*. In Codex Atlanticus, folio 1058v, Leonardo writes, "you may see that the beating of its wings against the air supports a heavy eagle in the highest and rarest atmosphere… a man with wings large enough and duly connected might learn to overcome the resistance of the air" (Hart 150). Leonardo believed that through the study of heavy birds of prey such as the eagle, he could uncover enough of nature's secrets to be able to mimic natural flight. Leonardo detailingly studied the physical aerodynamics that allowed birds to stay airborne. In folios 18r to 16v of "On the Flight of Birds", Leonardo attributes the suspension to the cone-shaped cushion of condensed air formed by the lateral and twisting motions of bird wings. Such detailed observation is surprisingly accurate considering the lack of stop-action photography which was used in the nineteenth century to more carefully study the flapping motion of birds.

Leonardo also noted the role of the tail, the alula – small tuft of small stiff feathers on the first digit of a bird's wing – and flight height in maintaining maneuverability and equilibrium, concepts that still maintain its importance in aerocraft design today. Aside from pure observations, Leonardo also built pulley machines that suspended dead birds from strings, explaining, "this is done to find the centre of gravity of the bird" (Hart 153). In a time before Newtonian physics, Leonardo recognized the role of gravity in maintaining balance and control, writing, "the heavier portion always guides the movement" (Hart 155). Leonardo's studies into birds, nature's perfected flying machines, represented one of mankind's first scientific attempts in understanding the theory of flight.

While naturalistic research helped Leonardo understand flight, mechanical designs were needed to achieve it. Leonardo's mechanical flying machine designs represent the early beginnings of aerocrafts in modern aviation. Thirteenth century philosopher Roger Bacon once envisioned, "an instrument may be made to fly… by which the wings, being artificially composed, may beat the air after the manner of a flying bird" (Hart 145). This vision served as a starting point for Leonardo as some of his early designs tried to mimic mechanics found in nature. In Codex Atlanticus, folio 1051v, Leonardo sketched out a flying machine design composed of two human-powered sets of mechanical wings that imitate the alternating movement of the double pair of dragonfly wings. "When part B goes up, part A has to go down, because there always has to be a part that is pressing down on air" (Launrenza 20). Leonardo also explored other non-natural designs, based on his earlier studies in aerodynamics, in his Manuscript B flying machine designs. Leonardo's "aerial screw" design in folio 83v was based on the theory that air could be compressed underneath the screw and can be used to push the screw upward when "quickly turned" (Laurenza 42). For his folio 80r "flying machine formed like the domed hull of a ship, with a pilot standing in the centre and four flapping wings", as historian Domenico Laurenza describes it, Leonardo designs the machine such that all parts of the human body is used to maximize the force generated for lifting the "ornithopter" and the body itself up into the air (Laurenza 44). In his famous bat-like flapping glider design or "Leonardo's flying machine" detailed out in Codex Atlanticus folios 848r, 846v, 824v, and 70br and again in Manuscript B folios 75r and 74v, Leonardo experiments with the idea of the pilot lying horizontally and steering by controlling movable wings. Leonardo eventually gave up after realizing that, using the heavy construction materials available to him during his time, the human power-to-weight ratio was too low to maintain flight. More recently, however, many of Leonardo's flying machine designs have been built using superior modern day materials. One of his designs, the "Leonardo's glider", was built and successfully tested in England, reportedly exceeding the first attempts of the Wright brothers (Kemp 127). While Leonardo was unsuccessful in his pursuits of the dream of flight, his efforts represented one of mankind's first serious attempts at designing flying machines.

Works Cited/Consulted

Capra, Fritjof. *The Science of Leonardo*. New York: Anchor Books, 2008. Print.

Kemp, Martin. *Leonardo*. New York: Oxford University Press, 2004. Print.

Hart, Ivor B. *The Mechanical Investigations of Leonardo da Vinci*. California: University of California Press, 1963. Print.

Laurenza, Domenico. *Leonardo on Flight*. Baltimore: The Johns Hopkins University Press, 2004. Print.

Scott, Phil. *The pioneers of flight: a documentary history*. New Jersey: Princeton University Press, 1999. Print.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/07

Final Portfolio

Descriptive Outline of Complex Synthesis Draft 1 of 3

Proposition: Leonardo was a pioneer of the science of flight.

Plan: To write a complex synthesis using research from various scholarly sources.

Paragraph 1:

Says: Leonardo was a pioneer of the science of flight.

Does: Sentences 1-3 state a historical achievement in aviation. Sentence 4 introduces Leonardo. Sentence 5 describes Capra's book. Sentences 6-7 describe Capra and Leonardo scholars' opinions. Sentence 8 states the proposition.

Paragraph 2:

Says: Leonardo studied flight by observing the best source available to him: nature.

Does: Sentence 1 states the first argument supporting the proposition. Sentences 2-4 state the names of relevant codices and the background history when Leonardo wrote them. Sentence 3 gives an example supporting the argument. Sentence 4 explains the example. Sentences 5-6 give another example supporting the argument. Sentence 7 explains the example. Sentence 8 gives another example and explanation. Sentence 9 gives yet another example. Sentence 10 explains the example. Sentence 11 concludes the paragraph.

Paragraph 3:

Says: Leonardo's mechanical flying machine designs represent the early beginnings of aerocrafts in modern aviation

Does: Sentence 1 states the second argument supporting the proposition. Sentences 2-4 explain the origins of Leonardo's fascination. Sentences 5-6 give an example supporting the argument and explain it through a quote. Sentence 7 expands on Leonardo's fascination. Sentence 8 gives another example and explains it. Sentence 9 gives yet another example and explains it. Sentence 10 states a problem that Leonardo encountered Sentence 11 gives a third example and explains it. Sentence 12 concludes the paragraph.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/03/24

Simple Synthesis Draft 2 of 2 (Final)

Final Portfolio

The Science of the Criticism of *The Science of Leonardo*

In his latest book *The Science of Leonardo*, scientist and author Fritjof Capra introduces readers to Leonardo da Vinci, a painter best known for his paintings such as the *Mona Lisa* and the *Last Supper*. As one of the world's greatest and most influential artists of the Renaissance, a period between the 14th and 17th century during which art culture flourished, Leonardo was also an avid scientist and engineer. Covering the life of "Leonardo, the Man" and "Leonardo, the Scientist" as two parts of his book, Capra connects Leonardo's artistic talent with his lesser known scientific studies. As the newest book by the author of numerous bestselling books such as *The Tao of Physics*, *The Science* has caught the eye of numerous book reviewers in a positive light. Critics see *The Science* as Capra's way of arguing for his personal view of Leonardo as the "true founder of modern science."

From the start, some critics note that Capra's highly emotional retelling of Leonardo's background. Trade news magazine *Publishers Weekly* is quick to point out Capra's emphasis on Leonardo's handicaps as an illegitimate child and his lack of access to formal education. The magazine notes Capra's use of emotional history to argue Leonardo's development of "his own holistic, empirical approach to science" (Publishers Weekly). Book reviewers for Barnes & Noble, the largest book retailer in the US, agrees, writing, "If we believe Fritjof Capra, it was Leonardo da Vinci's lack of schooling helped shape him as the seminal thinker of his time" (Barnes & Noble). Critics interpret this emotional touch as Capra's expression of "his own intellectual kinship with Leonardo" (Publishers Weekly) as nothing short of being a "deep admirer" (Barnes & Noble). Through highlighting the difficulties that Leonardo faced in his life, Capra, a modern scientist, shows his personal passion and admiration for Leonardo, a Renaissance scientist.

Capra's main focus purpose of *The Science* was, as the book's subtitle says, to give readers a look "inside the mind of the great genius of the Renaissance". Mathematics professor Ralph Abraham at University of California at Santa Cruz lists the many fields of science that Capra touch on: "a science of living forms, the movements of water, the forms of the living

earth, macrocosm and microcosm, nature's machines, and the mystery of human life" (Abraham). Librarian Sara Rutter at University of Hawaii at Manoa links Capra's view of the Leonardo as an "integrative, systematic thinker" with the author's push for moving away from the "reductive approach of scientific inquiry" that Capra has argued against in previous books (Rutter). Capra made it clear to critics that he saw Leonardo as the "first modern scientist, pioneer" (Abraham).

Works Cited

Abraham, Ralph. "Book Review." University of California at Santa Cruz. Web. 23 Mar. 2010. <www.ralph-abraham.org/reviews/capra-rvw.pdf>.

Barnes & Noble. "From Barnes & Noble." Barnes & Noble. Barnesandnoble.com llc. Web. 23 Mar. 2010. <http://search.barnesandnoble.com/The-Science-of-Leonardo/Fritjof-Capra/e/9781400078837#TABS>.

Publishers Weekly. "Nonfiction Reviews: Week of 8/20/2007." Publisher's Weekly. Reed Business Information. Web. 23 Mar. 2010. < http://www.publishersweekly .com/article/403255-Nonfiction_Reviews_Week_of_8_20_2007.php>.

Rutter, Sara. "Science & Technology." Library Journal. Reed Business Information. Web. 23 Mar. 2010. <http://www.libraryjournal.com/article/CA6471825.html>.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/03/24

Final Portfolio

Descriptive Outline of Simple Synthesis Draft 2 of 2 (Final)

Paragraph 1:

Says: Critics see *The Science* as Capra's way of arguing for Leonardo as the "true founder of modern science."

Does: Sentence 1 introduces Leonardo da Vinci. Sentence 2 describes Capra's book. Sentence 3 introduces book reviewers. Sentence 4 presents the view of critics.

Paragraph 2:

Says: Capra's main focus purpose of *The Science* was to give readers a look "inside the mind of the great genius of the Renaissance"

Does: Sentence 1 describes the author's purpose of the book. Sentence 2 expands on the purpose through examples. Sentence 3 links the book to previous books.

Paragraph 3:

Says: Some critics note that the author's tenability is hampered by the high degree to which Capra asserts sympathy for Leonardo.

Does: Sentence 1 introduces an issue. Sentences 2-3 expand on the issue with evidence. Sentence 4 refutes the issue. Sentence 5 supports the refutation.

Paragraph 4:

Says: All critics agree that Capra's thorough research into the subject is clearly reflected in *The Science*

Does: Sentence 1 gives a point of agreement. Sentences 2-3 explain the reason behind the agreement. Sentence 4 gives a related point of agreement. Sentence 5 gives the critic's recommendation to the reader.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/03/22

Simple Synthesis Draft 1 of 2

Final Portfolio

The Science of the Criticism of *The Science of Leonardo*

In his latest book *The Science of Leonardo*, scientist and author Fritjof Capra introduces readers to Leonardo da Vinci, a painter best known as one of the world's greatest and most influential artists of the Renaissance. Covering the life of "Leonardo, the Man" and "Leonardo, the Scientist" as two parts of his book, Capra connects Leonardo's artistic talent with his lesser known scientific studies. As the newest book by the author of numerous bestselling books such as *The Tao of Physics*, *The Science* has caught the eye of numerous book reviewers in a positive light. Critics see *The Science* as Capra's way of arguing for Leonardo as the "true founder of modern science."

Capra's main focus purpose of *The Science* was, as the book's subtitle says, to give readers a look "inside the mind of the great genius of the Renaissance". Capra made it clear to readers that he saw Leonardo as the first modern scientist and founder or visionary of many scientific fields such as complexity theory, ecology, and general systems theory. Critics link Capra's view of the Leonardo as an "integrative, systematic thinker" with the author's push for moving away from the reductive approach of scientific inquiry that Capra has argued against in previous books.

Some critics note that the author's tenability is hampered by the high degree to which Capra asserts sympathy for Leonardo. Capra's over-emphasis on Leonardo's handicaps as an illegitimate child and his lack of access to formal education may seem to some like an aggressive appeal to emotions for the sake of garnering reader support. This is reinforced in Capra's conclusion in which he underlines the unfortune of Leonardo's genius not being discovered earlier. On the other hand, some critics see this as a positive trait of the author. Through highlighting the difficulties that Leonardo faced as a front-line scientist, Capra shows his personal passion and admiration as a modern scientist for the Renaissance scientist that Leonardo was.

Regardless of the emotional aspect of the book, all critics agree that Capra's thorough research into the subject is clearly reflected in *The Science*. Capra used his Italian language skills to detailingly study recently transcribed *Notebooks* of Leonardo. Drawing from around 6 000

pages of notes and 100 000 sketches, Capra makes good use of his primary resources, extensively referencing them in his book and occasionally including scans of the original sketches. In the meantime, Capra is able to keep the textual content of his book easy to understand, follow and appreciate. Because of this, critics see *The Science* as a well supported book that is well suited for the casual reader.

Works Cited

Abraham, Ralph. “Book Review.” University of California at Santa Cruz. Web. 23 Mar. 2010. <www.ralph-abraham.org/reviews/capra-rvw.pdf>.

Barnes & Noble. “From Barnes & Noble.” Barnes & Noble. Barnesandnoble.com llc. Web. 23 Mar. 2010. <http://search.barnesandnoble.com/The-Science-of-Leonardo/Fritjof-Capra/e/9781400078837#TABS>.

Publishers Weekly. “Nonfiction Reviews: Week of 8/20/2007.” Publisher’s Weekly. Reed Business Information. Web. 23 Mar. 2010. < http://www.publishersweekly .com/article/403255-Nonfiction_Reviews_Week_of_8_20_2007.php>.

Rutter, Sara. “Science & Technology.” Library Journal. Reed Business Information. Web. 23 Mar. 2010. <http://www.libraryjournal.com/article/CA6471825.html>.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/03/22

Final Portfolio

Descriptive Outline of Simple Synthesis Draft 1 of 2

Paragraph 1:

Says: Critics see *The Science* as Capra's way of arguing for Leonardo as the "true founder of modern science."

Does: Sentence 1 introduces Leonardo da Vinci. Sentence 2 describes Capra's book. Sentence 3 introduces book reviewers. Sentence 4 presents the view of critics.

Paragraph 2:

Says: Capra's main focus purpose of *The Science* was to give readers a look "inside the mind of the great genius of the Renaissance"

Does: Sentence 1 describes the author's purpose of the book. Sentence 2 expands on the purpose through examples. Sentence 3 links the book to previous books.

Paragraph 3:

Says: Some critics note that the author's tenability is hampered by the high degree to which Capra asserts sympathy for Leonardo.

Does: Sentence 1 introduces an issue. Sentences 2-3 expand on the issue with evidence. Sentence 4 refutes the issue. Sentence 5 supports the refutation.

Paragraph 4:

Says: All critics agree that Capra's thorough research into the subject is clearly reflected in *The Science*

Does: Sentence 1 gives a point of agreement. Sentences 2-3 explain the reason behind the agreement. Sentence 4 gives a related point of agreement. Sentence 5 gives the critic's recommendation to the reader.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/03/15

Book Review Draft 2 of 2 (Final)

Final Portfolio

Book Review Draft 2 of *The Science of Leonardo* by Fritjof Capra

Leonardo da Vinci is best known as one of the world's greatest and most influential artists of the Renaissance, a period between the 14th and 17th century during which art culture flourished. Leonardo made numerous contributions to the world of art such as *The Mona Lisa* and *Last Supper*, and was highly praised all across Europe as a master of art, rivaled only by Michelangelo and Raphael. While Leonardo was best known as an artist, he was also an avid scientist and engineer. In his latest book, *The Science of Leonardo*, Fritjof Capra elegantly depicts Leonardo not only as a great Renaissance artist, but also as a scientific genius.

The Science was new grounds for author and scientist Fritjof Capra. Capra chose to leave the familiar, scientific world of particle physics and enter the unknown, artistic world of the Renaissance. Why? Capra respected Leonardo as the first modern scientist and that the *Leonardo approach* "cannot be understood without his art, nor his art without the science". Capra further explored Leonardo's Notebooks in order to rebuild Leonardo's personality and life as "a systematic thinker, ecologist, and complexity theorist; a scientist and artist with a deep reverence for all life, and as a man with a strong desire to work for the benefit of humanity". Capra recognized Leonardo as a "Renaissance Man" who excelled in more than just art. In doing so, Capra linked Leonardo's science to his art, the result of which was *The Science*.

The Science is presented in two parts: "Part One: Leonardo, The Man" and "Part Two: Leonardo, The Scientist". In the first part of the book, Capra introduces to the reader who Leonardo was and what was so special about him. Delving deep into Leonardo's personal life, Capra meticulously describes Leonardo's personality, artistic studies, and travels from birth till death. In the second part of the book, Capra explores Leonardo's scientific studies in a time before Newton and Galileo. Through linking Leonardo's art and designs to his scientific discoveries, Capra systematically covers Leonardo's studies in motion, geometry, light, and anatomy.

Capra presents a very thorough view of the scientific accomplishments of Leonardo, a man mostly known for his art. Capra is able to clearly highlight the scientific mind behind Leonardo's works of art and seamlessly link his systematic way of thinking to his revolutionizing

art techniques. While some portions of part two of the book may be too technical for some, *The Science* is overall an easy and comprehensive read for the casual reader. If you're interested in learning more about Leonardo's scientific mind and its connection with his beautiful artwork, *The Science of Leonardo* is a great starter.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/03/15

Final Portfolio

Descriptive Outline of Book Review Draft 2 of 2 (Final)

Paragraph 1:

Says: In his book *The Science of Leonardo*, Fritjof Capra presents Leonardo as an artist who was also a scientist.

Does: Sentences 1-3 introduce Leonardo da Vinci. Sentence 4 tells of another side of Leonardo. Sentence 5 explains what Capra does in his book.

Paragraph 2:

Says: As a physicist, Capra analyzed and explored Leonardo's scientific mind.

Does: Sentences 1-2 describe the author's position on the topic. Sentences 3-5 explain the author's reason for pursuing the topic. Sentence 6 presents the author's view of Leonardo. Sentence 7 explains the purpose of the book.

Paragraph 3:

Says: The book is presented as two parts, the first describing Leonardo and the second describing his scientific studies.

Does: Sentence 1 says the name of the two parts of the book. Sentences 2-3 describe the first part of the book. Sentences 4-5 describe the second part of the book.

Paragraph 4:

Says: Capra does a good job presenting the topic for casual readers.

Does: Sentences 1-2 comments on the book's ability in achieving its purpose. Sentence 3 describes the book's readability. Sentence 4 makes a recommendation to readers.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/03/03

Book Review Draft 1 of 2

Final Portfolio

Book Review Draft 1 of *The Science of Leonardo* by Fritjof Capra

Leonardo da Vinci is best known as one of the world's greatest and most influential artists of the Renaissance, a period between the 14th and 17th century during which art culture flourished. Leonardo made numerous contributions to the world of art such as *The Mona Lisa* and *Last Supper*. While Leonardo was best known as an artist, he was also an avid scientist and engineer. In his latest book, *The Science of Leonardo*, Fritjof Capra depicts Leonardo not only as a great Renaissance artist, but also as a scientific genius.

Having written numerous bestselling books on science and systems, *The Science* was new grounds for author and scientist Fritjof Capra. To be able to research into the great artist, Capra left the world of particle physics and entered the world of Renaissance art. Why? Respecting Leonardo as the first modern scientist, Capra strived to better understand the "Leonardo approach" which "cannot be understood without his art, nor his art without the science". Recognizing the significance of the patterns in Leonardo's artwork, Capra further explored Leonardo's Notebooks in order to rebuild Leonardo's personality and life as "a systematic thinker, ecologist, and complexity theorist; a scientist and artist with a deep reverence for all life, and as a man with a strong desire to work for the benefit of humanity". In doing so, Capra linked Leonardo's science to his art, the result of which was this book.

The Science is presented in two parts: "Part One: Leonardo, The Man" and "Part Two: Leonardo, The Scientist". In the first part of the book, Capra introduces to the reader who Leonardo was and what was so special about him. Delving deep into Leonardo's personal life, Capra describes Leonardo's personality, artistic studies, and travels from birth till death. In the second part of the book, Capra describes Leonardo's scientific studies in the time before Newton and Galileo. Through linking Leonardo's art and designs to his scientific discoveries, Capra systematically covers Leonardo's studies in motion, geometry, light, and anatomy.

Despite being a theoretical physicist, Capra presents a very deep and thorough look at Leonardo, a man best known for his art. Capra is able to clearly highlight the scientific mind behind Leonardo's works of art and seamlessly link his systematic way of thinking to explain Leonardo's art techniques. While some portions of the second part of the book may touch on

some areas of mathematics a bit too technical for some readers, *The Science* is overall an easy and comprehensive read for the casual reader. If you're interested in learning more about Leonardo's scientific minds and its connection with his beautiful artwork, this is a great starter.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/03/15

Final Portfolio

Descriptive Outline of Book Review Draft 1 of 2

Paragraph 1:

Says: In his book *The Science of Leonardo*, Fritjof Capra presents Leonardo as an artist who was also a scientist.

Does: Sentences 1-3 introduce Leonardo da Vinci. Sentence 4 tells of another side of Leonardo. Sentence 5 explains what Capra does in his book.

Paragraph 2:

Says: As a physicist, Capra analyzed and explored Leonardo's scientific mind.

Does: Sentences 1-2 describe the author's position on the topic. Sentences 3-6 explain the author's reason for pursuing the topic.

Paragraph 3:

Says: The book is presented as two parts, the first describing Leonardo and the second describing his scientific studies.

Does: Sentence 1 says the name of the two parts of the book. Sentences 2-3 describe the first part of the book. Sentences 4-5 describe the second part of the book.

Paragraph 4:

Says: Capra does a good job presenting the topic for casual readers.

Does: Sentences 1-2 comments on the book's ability in achieving its purpose. Sentence 3 describes the book's readability. Sentence 4 makes a recommendation to readers.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/04/21

Iron Person Draft 4 of 4 (Final) + Conclusion

Final Portfolio

The Dark da Vinci

The Renaissance was a period of high prosperity. Artists from all over Europe produced numerous bright and elegant works of art that brought fascination to the imagination. Leonardo da Vinci was one of the period's greatest and most prominent artists. He enchanted the nobles such as duchess Isabella d'Este who noted “this air of sweetness and gentleness that is so characteristic of him” (Capra 20). While he was seen as an extravagant figure of his time, Leonardo had a dark side to him that strongly contradicted his public image. As pure and charming as his fellow Florentines saw him, Leonardo harboured a more sinister personality. Leonardo was a sadist.

In the public eye, Leonardo showed himself to have a gentle personality. Leonardo displayed a passionate love for nature and the animals around him. He was a vegetarian, an extreme rarity in his time and a path chosen only by those most dedicated to animal life. In a famous story from famous biographer Giorgio Vasari, “often when he (Leonardo) was walking past the places where birds were sold he would pay the price asked, take them from their cages, and let them fly off into the air, giving them back their lost freedom” (Capra 21). His actions showed to the world that animals were meant to have their freedom as nature intended. Leonardo also declared himself a pacifist who strongly opposed warfare. When Leonardo was commissioned to draw *The Battle of Anghiari* to commemorate a historical military victory, Leonardo used the central piece of the fresco to express his opposition to the war. Vasari described the confusing struggle depicted in Leonardo's designs as a composition of “fury, hate, and rage”, combined with unrealistic theatrical costumes worn by the combatants to symbolize Leonardo's condemnation of such wars.

Leonardo's hidden side, on the other hand, strongly reveals his deeper, sadistic personality. Leonardo took pleasure in the physical mutilation of animal carcasses. While Leonardo openly admired the beauty of natural beasts, he took liberty in his interest of grotesquely distorting them with the purpose of enticing terror. On one occasion where his father Ser Piero da Vinci handed Leonardo a buckler to decorate, Leonardo collected a wide assortment of animal carcasses and “assembled different parts to create a fearsome and horrible monster” (Capra 69). Given a first for unconstrained self expression in art, Leonardo not only uses the parts of dead animals but uses it in a manner which creates an abomination far more horrible than nature ever intended to exist. Leonardo also enjoyed using his horrific creations to inflict psychological suffering on others. Vasari described how after obtaining a large lizard, Leonardo attached “with a mixture of

quicksilver some wings, made from the scales stripped from other lizards, which quivered as it walked along. Then, after he had given it eyes, horns, and a beard, he tamed the creature, and keeping it in a box he used to show it to his friends and frighten the life out of them" (Capra 26). Disfiguring the lizard's natural form, Leonardo took pleasure in shocking his friends through his cruel humour. Leonardo's hidden sadism was not only limited to his interest in creating terror however. Leonardo was also fascinated with destruction. While Leonardo publicly declared himself a pacifist, his private works proved otherwise. Even though he had not personally participated on the front line, Leonardo was able to vividly imagine the horrifying scenes. He emphasized the gory nature of the battle in his descriptions, writing "let the air be full of arrows of all kinds... paint a horse dragging the dead body of its master... represent others crying out with their mouths wide open and running away...; others in the agonies of death grinding their teeth, rolling their eyes, with their fists clenched against their bodies, and their legs contorted" (Ms. Ashburnham II). Such lively and terrifying descriptions could only indicate his sadistic fascination in the pains and torturing of the dying soldiers.

Personality is in eye of the beholder. Because the Renaissance was a period of extreme artistical prosperity, scholars often view the era as a positive period in history. Such association is undoubtly the reason for common views of Leonardo's personality biased toward the gentleness described by his associates. One must always consider, however, the context of such evidence. Friends and clients will only voice positive views of individuals, even if their actual opinions contradict their words or if they lack sufficient familiarity with the person. The Romans, for example, are best known for their triumphant conquest of the Mediterranean, but horrid stories of their war crimes are often neglected from history texts. The *Horrible History* series tries to shed light on such conveniently-forgotten negativities in history; however, such books are rare even today. Nevertheless, all that holds importance in the end are pure facts. Unfortunately, the majority of Leonardo scholars will ignore such signs and help create popular opinion. After all, it has always been human nature to ignore the ugly and judge the world through rose-coloured glasses. We prefer to see Leonardo in most glowing terms.

Works Cited

Capra, Fritjof. *The Science of Leonardo.* New York: Anchor Books, 2008. Print.

Ms. Ashburnham II, folios 31r and 30v.

Detailed Descriptive Outline, Iron Person, Draft 4 of 4 (Final) + Conclusion

Proposition: Leonardo was a sadist.

Plan: To write an Iron Person essay supporting the proposition.

Paragraph 1:

Says: Sentences 1-2 describes the Renaissance. Sentence 3 says that Leonardo was a great artist. Sentence 4 gives a quote from a Duke that describes Leonardo. Sentence 5 says that Leonardo had a dark side. Sentence 6-7 says that Leonardo was a sadist.

Does: Sentences 1-2 explains the historical backdrop of Leonardo's life. Sentence 3 explains Leonardo's place in the Renaissance. Sentence 4 establishes the fact that Leonardo's peers saw him as a positive person. Sentence 5 refutes sentence 4. Sentence 6-7 states the proposition.

Paragraph 2:

Says: Sentence 1 says that Leonardo was gentle to the public. Sentence 2 says that Leonardo loved animals. Sentence 3 says that Leonardo was a vegetarian. Sentence 4 says that Leonardo often set free birds. Sentence 5 says that he did this to give the birds freedom. Sentence 6 says Leonardo was a pacifist. Sentence 7 says Leonardo used a fresco commission to show his opposition to war. Sentence 8 says that the fresco's content showed Leonardo's condemation of the war.

Does: Sentence 1 states the opposition. Sentence 2 gives the first counter-argument. Sentence 3 gives an example supporting the first counter-argument. Sentence 4 gives another example supporting the first counter-argument. Sentence 5 explains the examples. Sentence 6 gives the second counter-argument. Sentence 7 gives an example supporting the second counter-argument. Sentence 8 gives an expert's interpretation of the example in sentence 7 and explains the example.

Paragraph 3:

Says: Sentence 1 says that Leonardo had a hidden sadistic personality. Sentences 2-3 say that Leonardo enjoyed animal mutilation. Sentence 4 says that Leonardo created grotesque animal art. Sentence 5 says Leonardo intended to turn the dead animals into a horrific piece of art. Sentence 6 says that Leonardo enjoyed shocking his peers. Sentence 7 describes another horrific piece of art which Leonardo used to scare his friends. Sentence 8 says that Leonardo enjoyed cruel humour. Sentences 9-11 say that Leonardo enjoyed war. Sentence 12 says that Leonardo was able to gruesomely describe a war scene. Sentence 13 says that Leonardo was fascinated with the soldiers' deaths.

Does: Sentence 1 restates the proposition. Sentences 2-3 give the first reason supporting the proposition. Sentence 4 gives an example supporting the first reason. Sentence 5 explains the example. Sentence 6 gives a second reason supporting the proposition. Sentence 7 gives an example supporting the second reason. Sentence 8 explains the example. Sentences 9-11 give the third reason supporting the proposition. Sentence 12 gives an example supporting the third reason. Sentence 13 explains the example.

Paragraph 4:

Says: Personality is in eye of the beholder.

Does: Sentence 1 states a generalized conclusion that can be drawn from the essay. Sentences 2-5 explain why the counter-opinion is the common opinion. Sentences 6-7 give an example supporting the essay's general opinion. Sentence 8 states a general scientific method of analysis. Sentence 9 uses the general scientific method of analysis to justify the essay's proposition. Sentences 10-11 acknowledge the failure of the scientific method when applied to human opinions, giving the reader something to reflect on.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/02/25

Iron Person Draft 4 of 4 (Final)

Final Portfolio

The Dark da Vinci

The Renaissance was a period of high prosperity. Artists from all over Europe produced numerous bright and elegant works of art that brought fascination to the imagination. Leonardo da Vinci was one of the period's greatest and most prominent artists. He enchanted the nobles such as duchess Isabella d'Este who noted “this air of sweetness and gentleness that is so characteristic of him” (Capra 20). While he was seen as an extravagant figure of his time, Leonardo had a dark side to him that strongly contradicted his public image. As pure and charming as his fellow Florentines saw him, Leonardo harboured a more sinister personality. Leonardo was a sadist.

In the public eye, Leonardo showed himself to have a gentle personality. Leonardo displayed a passionate love for nature and the animals around him. He was a vegetarian, an extreme rarity in his time and a path chosen only by those most dedicated to animal life. In a famous story from famous biographer Giorgio Vasari, “often when he (Leonardo) was walking past the places where birds were sold he would pay the price asked, take them from their cages, and let them fly off into the air, giving them back their lost freedom” (Capra 21). His actions showed to the world that animals were meant to have their freedom as nature intended. Leonardo also declared himself a pacifist who strongly opposed warfare. When Leonardo was commissioned to draw *The Battle of Anghiari* to commemorate a historical military victory, Leonardo used the central piece of the fresco to express his opposition to the war. Vasari described the confusing struggle depicted in Leonardo's designs as a composition of “fury, hate, and rage”, combined with unrealistic theatrical costumes worn by the combatants to symbolize Leonardo's condemnation of such wars.

Leonardo's hidden side, on the other hand, strongly reveals his deeper, sadistic personality. Leonardo took pleasure in the physical mutilation of animal carcasses. While Leonardo openly admired the beauty of natural beasts, he took liberty in his interest of grotesquely distorting them with the purpose of enticing terror. On one occasion where his father Ser Piero da Vinci handed Leonardo a buckler to decorate, Leonardo collected a wide assortment of animal carcasses and “assembled different parts to create a fearsome and horrible monster” (Capra 69). Given a first for unconstrained self expression in art, Leonardo not only uses the parts of dead animals but uses it in a manner which creates an abomination far more horrible than nature ever intended to exist. Leonardo also enjoyed using his horrific creations to inflict psychological suffering on others. Vasari described how after obtaining a large lizard, Leonardo attached “with a mixture of

quicksilver some wings, made from the scales stripped from other lizards, which quivered as it walked along. Then, after he had given it eyes, horns, and a beard, he tamed the creature, and keeping it in a box he used to show it to his friends and frighten the life out of them" (Capra 26). Disfiguring the lizard's natural form, Leonardo took pleasure in shocking his friends through his cruel humour. Leonardo's hidden sadism was not only limited to his interest in creating terror however. Leonardo was also fascinated with destruction. While Leonardo publicly declared himself a pacifist, his private works proved otherwise. Even though he had not personally participated on the front line, Leonardo was able to vividly imagine the horrifying scenes. He emphasized the gory nature of the battle in his descriptions, writing "let the air be full of arrows of all kinds... paint a horse dragging the dead body of its master... represent others crying out with their mouths wide open and running away...; others in the agonies of death grinding their teeth, rolling their eyes, with their fists clenched against their bodies, and their legs contorted" (Ms. Ashburnham II). Such lively and terrifying descriptions could only indicate his sadistic fascination in the pains and torturing of the dying soldiers.

Works Cited

Capra, Fritjof. *The Science of Leonardo.* New York: Anchor Books, 2008. Print.

Ms. Ashburnham II, folios 31r and 30v.

Detailed Descriptive Outline, Iron Person, Draft 4 of 4 (Final)

Proposition: Leonardo was a sadist.

Plan: To write an Iron Person essay supporting the proposition.

Paragraph 1:

Says: Sentences 1-2 describes the Renaissance. Sentence 3 says that Leonardo was a great artist. Sentence 4 gives a quote from a Duke that describes Leonardo. Sentence 5 says that Leonardo had a dark side. Sentence 6-7 says that Leonardo was a sadist.

Does: Sentences 1-2 explains the historical backdrop of Leonardo's life. Sentence 3 explains Leonardo's place in the Renaissance. Sentence 4 establishes the fact that Leonardo's peers saw him as a positive person. Sentence 5 refutes sentence 4. Sentence 6-7 states the proposition.

Paragraph 2:

Says: Sentence 1 says that Leonardo was gentle to the public. Sentence 2 says that Leonardo loved animals. Sentence 3 says that Leonardo was a vegetarian. Sentence 4 says that Leonardo often set free birds. Sentence 5 says that he did this to give the birds freedom. Sentence 6 says Leonardo was a pacifist. Sentence 7 says Leonardo used a fresco commission to show his opposition to war. Sentence 8 says that the fresco's content showed Leonardo's condemnation of the war.

Does: Sentence 1 states the opposition. Sentence 2 gives the first counter-argument. Sentence 3 gives an example supporting the first counter-argument. Sentence 4 gives another example supporting the first counter-argument. Sentence 5 explains the examples. Sentence 6 gives the second counter-argument. Sentence 7 gives an example supporting the second counter-argument. Sentence 8 gives an expert's interpretation of the example in sentence 7 and explains the example.

Paragraph 3:

Says: Sentence 1 says that Leonardo had a hidden sadistic personality. Sentences 2-3 say that Leonardo enjoyed animal mutilation. Sentence 4 says that Leonardo created grotesque animal art. Sentence 5 says Leonardo intended to turn the dead animals into a horrific piece of art. Sentence 6 says that Leonardo enjoyed shocking his peers. Sentence 7 describes another horrific piece of art which Leonardo used to scare his friends. Sentence 8 says that Leonardo enjoyed cruel humour. Sentences 9-11 say that Leonardo enjoyed war. Sentence 12 says that Leonardo was able to gruesomely describe a war scene. Sentence 13 says that Leonardo was fascinated with the soldiers' deaths.

Does: Sentence 1 restates the proposition. Sentences 2-3 give the first reason supporting the proposition. Sentence 4 gives an example supporting the first reason. Sentence 5 explains the example. Sentence 6 gives a second reason supporting the proposition. Sentence 7 gives an example supporting the second reason. Sentence 8 explains the example. Sentences 9-11 give the third reason supporting the proposition. Sentence 12 gives an example supporting the third reason. Sentence 13 explains the example.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/02/15

Peer Review

Descriptive / Evaluative Peer Review of Jeff Desilets

Iron Person Essay, Draft 1 of 2

Proposition: Leonardo is truly a one-of-a-kind artist.

Plan: To write an Iron Person essay supporting the proposition.

Paragraph 1
Says: Leonardo is a well-respected and renowned artist to the general public.

Does: Introduces the proposition.

Paragraph 2
Says: The works for which Leonardo was famous for were not unique.

Does: Supports the argument by giving examples of works that Leonardo should not have been famous for.

Paragraph 3
Says: Leonardo was unique due to his skill and abilities.

Does: Supports the argument by giving examples of ways in which Leonardo showed unique talents.

Evaluative:

The opening of this essay needs to be more catchy and interesting to readers. Starting with a rhetorical question not only makes the assumption that the reader knows who "Leonardo" is but also that the reader also holds the personal opinion that Leonardo was great. Try "Leonardo da Vinci was a great artist who was respected by the general public for his amazing works". Such a more neutral opener both introduces the artist and is more agreeable by the reader, putting the reader in a position to want to continue reading the essay. The proposition needs more clarification and needs to be more concise; what defines a "one-of-**a**-kind" artist? The reasoning

and examples in the third paragraph do not clearly support the proposition of Leonardo being unique but instead says Leonardo was a good artist. This can be improved through clarifying the term “unique” and linking each example to the definition of “unique” through phrases such as “he was the only artist of his time that…”.

Substantiative:

Many sentences need rephrasing to sound more solid; remove phrases such as “is perhaps” and “is suppose to be”. The third paragraph needs major grammatical revisioning. In the sentence “he had the genius to truly understand”, replace the word “genius” with a descriptive word describing mental state such as “ingenuity”. In the very final sentence of the third paragraph, remove the phrase “In conclusion”; there is an entire (yet-to-be-written) fourth paragraph for that!

Iron Person Draft 1 of 2 by Jeff Desilets peer reviewed by Philip Peng

One in a Million

Who would say that Leonardo wasn't a great artist? The general public respects Leonardo's work as truly amazing. His *Mona Lisa* is perhaps the most recognizable paintings in Western culture. His sketches of the *Vitruvian Man* are familiar to even the least artistic citizens. Dan Brown's "Da Vinci Code" sold over 80 million copies worldwide. A book based on the works of any other artist could not possibly have had the same mass appeal. Leonardo is truly a one-of-kind artist.

But when you stop to think about it, was Leonardo really that unique? Leonardo's da Vinci's *Mona Lisa* is supposed to be famous for its mysterious smile. But spend an afternoon patrolling the corridors of the Louvre and you'll find hundreds of paintings of mysterious smiles, many of which more capable of presenting an air of mystery. Some historians only believe that Leonardo's *Mona Lisa* is only as famous as it is because he spent so many years painting and repainting it. Is that really a good enough reason to make it the most recognizable work of art on the planet? Leonardo is also famous for many of his inventions. However, very few of Leonardo's machines were actually commissioned to be built. Furthermore, Leonardo did not finish many of his works. Countless paintings lay dormant still in the "sketching" phase stripped of color and ornamentation. In fact, the works that Leonardo is most famous for are his unfinished sketches. If Leonardo did not finish his many works, and those that he did finish were not any different from other artists, why then is Leonardo considered the ultimate Renaissance Man?

The truth that Leonardo is so famous because he was unique; no other artist or inventor possessed the same array of abilities that Leonardo encompassed. Not only could he draw, but he had the genius to truly understand the objects that he drew. When Leonardo drew images of life, he was able to do so with a deep understand of how each organ functioned and was able to draw them in such a way that incorporated form and function. He was also an extraordinary problem-solver. Whatever problems he could think of, he could invent a simple device to overcome the challenge in question. For example, Leonardo identified that attacking armies used ladders to storms castles, so he invented a device that could overturn the ladders of invaders. In addition, Leonardo's artworks may seem comparable to other artists' works to the untrained eye, but a true connoisseur knows that few artists can portray light, create perspective, or blur sfumato quite the same way that Leonardo did. The proportions of his drawings are also startlingly realistic. In conclusion, Leonardo's amazing abilities make him truly one of a kind.

Custom Proofreading Sheet

Incorrect Sentence	**Corrected Sentence**	**Hacker Manual**	**Type**
After Antigone had buried her brother, she was brought to the court and **questioned** by the king.	After Antigone had buried her brother, she was brought to the court and **was questioned** by the king.	P34 12b	Pronoun reference A pronoun should refer clearly to its antecedent. When it does not, it is usually because of ambiguous, implied, vague or indefinite reference.
The modern American family differs in many significant ways from **their** nineteenth-century counterpart.	The modern American family differs in many significant ways from **its** nineteenth-century counterpart.	P32 12a	Pronoun-antecedent agreement The antecedent of a pronoun is the word the pronoun refers to. A pronoun and its antecedent agree when they are both singular or both plural.
Pablo said that sports had taught him to follow instructions, to prepare for games, to adjust to new situations, and **the value of** losing as well as winning.	Pablo said that sports had taught him to follow instructions, to prepare for games, to adjust to new situations, and **to value** losing as well as winning.	P5 3a	Items in a series Balance all items in a series by presenting them in parallel grammatical form.
The seventeen-year locusts have descended on our town and their noise actually drowns out my daughter's music.	The seventeen-year locusts have descended on our town**,** and their noise actually drowns out my daughter's music.	P58 17a	The comma – Before a coordinating conjunction joining independent clauses When a coordinating conjunction connects two or more independent clauses-word groups that could stand alone as separate sentences-a comma must precede it. There are seven coordinating conjunctions in English: and, but, or, nor, for, so, and yet.
Four people saw the accident, but not one of	Four people saw the accident, but not one of	P32 12a	Pronoun-antecedent agreement –

them said **they** would be a witness for me in court.	them said **he or she** would be a witness for me in court.		Indefinite pronouns Indefinite pronouns refer to nonspecific persons or things. Even though some of the following indefinite pronouns may seem to have plural meanings, treat them as singular in formal English: anybody, anyone, anything, each, either, everybody, everyone, everything, neither, nobody, no one, nothing, somebody, someone, something.
Andrea knew she had done **good** on the essay part of the exam, but she felt bad about her performance on the objective questions.	Andrea knew she had done **well** on the essay part of the exam, but she felt bad about her performance on the objective questions.	P40 13a	Adverbs Use adverbs, not adjectives, to modify verbs, adjectives, and adverbs. Adverbs usually answer one of these questions: When? Where? How? Why? Under what conditions? How often? To what degree?
The navy taught my dad how to be a plumber. He's not employed as a plumber now, but he does **it** part-time to earn extra money.	The navy taught my dad how to be a plumber. He's not employed as a plumber now, but he does **plumbing** part-time to earn extra money.	P34 12b	Pronoun reference A pronoun should refer clearly to its antecedent. When it does not, it is usually because of ambiguous, implied, vague, or indefinite reference.
It's not that Marcia doesn't understand the problem; she won't even accept **it's** existence.	It's not that Marcia doesn't understand the problem; she won't even accept **its** existence.	P68 19a	The apostrophe - To indicate possession The apostrophe is used to indicate that a noun or an indefinite pronoun is possessive. Possessives usually indicate ownership, as in Tim's hat, the editor's desk, or someone's gloves.
As Toni lay down to take a nap, she laid her paycheck on the nightstand; it stayed	As Toni lay down to take a nap, she laid her paycheck on the nightstand; it stayed	P26 11a	Irregular verbs - Distinguishing between lie and lay Writers often confuse the forms of lie

there for two days before she noticed it **lying** there.	there for two days before she noticed it **laying** there.		(meaning "to recline or rest on a surface") with lay (meaning "to put or place something"). Base Form/Past Tense/Past Participle/Present Participle lie lay lain lying lay laid laid laying
Everyone who **shops** in this store **reads** the magazines while they wait in the checkout line.	**All customers** who **shop** in this store **read** the magazines while they wait in the checkout line.	P32 12a	Pronoun-antecedent agreement – Indefinite pronouns Indefinite pronouns refer to nonspecific persons or things. Even though some of the following indefinite pronouns may seem to have plural meanings, treat them as singular in formal English: anybody, anyone, anything, each, either, everybody, everyone, everything, neither, nobody, no one, nothing, somebody, someone, something.
A man **that** lived in the late fifteenth century…	A man **who** lived in the late fifteenth century…	P39 12d	who or whom Who, a subjective-case pronoun, can be used only for subjects and subject complements. Whom, an objective-case pronoun, can be used only for objects. The words who and whom appear primarily in subordinate clauses or in questions.

Philip Peng

Leonardo: Scientist and Artist

Professor Jo Caplin

2010/03/01

Book Outline

Final Portfolio

Book Outline of *The Science of Leonardo* by Fritjof Capra

Acknowledgements:

Says: The author is especially grateful to numerous individuals for helping him orient himself in the world of Leonardo scholarship

Does: Names numerous people whom the author gives thanks.

Preface:

Says: Leonardo's mind was unique in his scientific methods of thinking and captured the author's interest as a scientist who was also an artist.

Does: Describes the author's history involvement in studying Leonardo and his own fascination with Leonardo.

Introduction:

An Interpreter of Nature:

Says: Leonardo went against the way of scientific thinking of his time and recorded his thoughts and observations in his Notebooks.

Does: Introduces Leonardo's background and common scientific thinking during his time, then describes the Notebooks.

The Science of Painting

Says: Leonardo was a visual artist and used this trait in his studies of science.

Does: Introduces Leonardo's view on the connection between art and science.

The Nature of Life

Says: Leonardo saw the Earth as a fully living thing and seeked to understand the connections between microcosm and macrocosm.

Does: Describes Leonardo's view of nature and his desire to understand it.

A Systematic Thinker

Says: Leonardo was a systematic thinker that studied and understood patterns.

Does: Describes Leonardo's way of scientific thinking and how it connects to modern thinkers.

Synthesis of Art and Science

Says: Leonardo used his drawings to understand and investigate science.

Does: Describes the role of art in Leonardo's studies of science.

The Eye and The Appearance of Forms

Says: Leonardo based his science on systematic observations.

Does: Describes the role of observations in his studies of science.

The Living Forms of Nature

Says: Leonardo studied the living forms of nature to understand the mechanics of motion.

Does: Describes Leonardo's studies of the human and animal body.

Leonardo's Legacy

Says: Leonardo's way of thinking can help us better our understanding of the world.

Does: Connects Leonardo's way of thinking with the modern world.

Part One - Leonardo, The Man

Section One - Infinite Grace

Infinite Grace

Says: Giorgio Vasari was a rich primary source for information about Leonardo

Does: Introduces a Leonard expert which the author draws information from.

Qualities and Appearances

Says: Leonardo was physically a very beautiful man himself.

Does: Describes the physical appearance of Leonardo.

Character Traits

Says: Leonardo was a very confident man and passionate about nature and life.

Does: Describes Leonardo's personality and character traits.

Secrecy and Contradictions

Says: Leonardo showed many contradictory characteristics and was very secretive about his thoughts, sexuality, and scientific discoveries.

Does: Describes the contradiction and secrecy in Leonardo's life.

Signs of Genius

Says: The source of Leonardo's genius comes from his rich life.

Does: Defines "genius" and tries to explain how Leonardo fits in that definition.

Section Two - The Universal Man

The Universal Man

Says: Leonardo was a universal man during the Renaissance.

Does: Defines a “universal” man and explains how Leonardo was one.

Leonardo’s Synthesis

Says: Leonardo believed that an artist’s imagination was connected to his understanding of nature.

Does: Explains Leonardo’s view on the connection between art and science.

The Sublime Left Hand

Says: Leonardo’s techniques in his drawings were very dynamic and unprecedented.

Does: Describes Leonardo’s unique and dynamic art style.

The Soul of Painting

Says: Leonardo committed himself in the advancement of painting technique through recording and sharing painting methods.

Does: Describes Leonardo’s role in the advancement of painting techniques.

Discorso Mentale

Says: Leonardo focused on the intellectual, mental process of painting and used it to produce many innovative paintings.

Does: Describes how Leonardo used oil-based paints to develop many innovative painting techniques.

Il Cavallo

Says: Leonardo was known as a sculptor for his one unfinished monumental bronze horse.

Does: Describes Leonardo’s life as a sculptor.

Leonardo the Designer

Says: Leonardo was designer in the modern definition of design.

Does: Describes Leonardo's design abilities.

From Engineering to Science

Says: Leonardo's want to know "why" lead him to shift his interest from engineering to science.

Does: Describes the connection between Leonardo's interest in engineering and science.

Architectural Design

Says: Leonardo was known as an architect due to his interest in design despite never being involved in any architecture.

Does: Describes why some view Leonardo as an architect.

The Artist as Magician

Says: Leonardo's used his abilities as a designer to orchestrate many performances.

Does: Describes why some view Leonardo as a magician.

Interwoven Strands

Says: Leonardo created many symbolic artworks with deep meanings

Does: Describes various symbolic works done by Leonardo.

Section Three - The Florentine

The Florentine

Says: Leonardo was known as a Florentine.

Does: Introduces Leonardo's travel life and his connection with Florence.

Childhood in Vinci

Says: Leonardo was born and grew up in Vinci.

Does: Describes Leonardo's childhood in Vinci.

Apprenticeship in Florence

Says: Leonardo started his art apprenticeship under Andrea del Verrocchio.

Does: Describes Leonardo's apprenticeship in Florence.

Young Master Painter and Inventor

Says: Leonardo developed as an independent artist after he left Verrocchio

Does: Describes Leonardo's art life after completing his apprenticeship.

Milan

Says: Leonardo continued on as a painter and engineer in Milan.

Does: Describes Leonardo's circumstances in moving to Milan and his art history in Milan.

Systematic Studies

Says: Leonardo used systematic self-education to become accepted by the academic world.

Does: Describes the period of Leonardo's life during which he concentrated on systematic self-studies.

Gradual Acceptance at Court

Says: Leonardo participated in numerous events helped him achieve a renowned status throughout Italy.

Does: Describes events leading up to Leonardo becoming famous country-wide.

Section Four - A Well-Employed Life

A Well-Employed Life

Says: Leonardo had become a famous artist and was highly in demand.

Does: Describes Leonardo's life as a famous court artist.

New Focus on Mathematics

Says: Leonardo spent many years researching geometry and mechanics.

Does: Describes Leonardo's research into mathematics.

Friendship and Betrayal

Says: Leonardo's fresco *Last Supper* was marveled during his time and after.

Does: Describes the lead up to and process of painting *Last Supper*.

Political Turmoil

Says: Due to political changes, Leonardo left Milan.

Does: Describes the political events leading up to Leonardo's leaving of Milan.

Return to Florence

Says: Leonardo travelled around the country and created many artistic works before returning to Florence.

Does: Describes Leonardo's life after Milan and his return to Florence.

Travels in Central Italy

Says: Leonardo travelled around Italy as an engineer.

Does: Describes Leonardo's travels around the country as an engineer of Florence.

Flights of Fancy

Says: Leonardo recorded many observations of the flowing of water and flight patterns.

Does: Describes Leonardo's studies of water and flight during wartime.

A Stage of Maturity

Says: Upon returning to Milan, Leonardo matured in his science and his art through narrowing down his focus.

Does: Describes Leonardo's stage of maturity in his artistic developments and scientific studies.

Last Years in Milan

Says: Leonardo was forced to leave Milan again due to political turmoil.

Does: Explains the circumstances under which Leonardo left Milan.

Frustration in Rome

Says: Leonardo moved to Rome but as an eclipsed and aged artist.

Does: Describes the gloomy background under which Leonardo tried to continue his art.

Last Journeys

Says: Leonardo became a royal painter in the court of France.

Does: Describes the events leading up to his appointment as a royal painter of France.

The Philosopher and The King

Says: Leonardo was appreciated and acclaimed by the King of France and Cardinal of Aragorn as a scientist for his works.

Does: Describes Leonardo's relationship with the young King of France and his works at Amboise leading up to his death.

The Fate of the Notebooks

Says: Leonardo's Notebook was fragmented and its parts scattered across the country.

Does: Describes the fate of Leonardo's Notebook after his death.

Part Two - Leonardo, The Scientist

Section Five - Science in the Renaissance

Science in the Renaissance

Says: Leonardo build his science upon traditional texts and modifying theories in accordance with the scientific method.

Does: Introduces Leonardo's approach to studying science.

The Rediscovery of the Classics

Says: Science was derived from the principal ideas of ancient philosophy.

Does: Describes the history of scientific knowledge.

The Invention of Printing

Says: Leonardo recognized the power of printing in reproducing his works and texts.

Does: Describes the role of printing in Leonardo's works

The World of Exploration

Says: Leonardo was an avid mental and physical explorer

Does: Describes the role of exploration in Leonardo's life.

The Ancient View of the Universe

Says: The view of the universe during the Renaissance was based on classical Greek science.

Does: Describes ancient Greek science and philosophy.

Aristotle's Synthesis of Science

Says: Renaissance science strongly followed Aristotelian views.

Does: Describes the basis of Renaissance science.

Mathematics and Astronomy at the Time of Leonardo

Says: Math and astronomy during Leonardo's time was ancient Greek texts.

Does: Describes the basis of Renaissance math and astronomy.

Natural History

Says: Botany and animal studies were based on Aristotle and Pliny.

Does: Describes the basis of Renaissance natural studies.

Medicine and Anatomy

Says: Medicine and health were based on Hippocrates, Galen and Avicenna.

Does: Describes the basis of Renaissance medical studies.

Leonardo and the Classics

Says: Leonardo owned and studies numerous classical texts during his self-education.

Does: Describes Leonardo's studies and views of classical science.

Section Six - Science Born of Experience

Science Born of Experience

Says: The definition of "science" has changed over the centuries.

Does: Describes various definitions and understandings of "science".

The Scientific Method

Says: The scientific method involved connecting observations with theory.

Does: Describes the modern scientific method.

Leonardo's Empirical Approach

Says: Leonardo relied on direct observation of nature for his science.

Does: Describes the role of empirical observation in Leonardo's scientific studies.

The Notebooks

Says: Leonardo recorded his thoughts in thousands of disjoint notes and drawings.

Does: Describes Leonardo's Notebooks.

A Science of Living Forms

Says: Leonardo made numerous proportional drawings of human, plant and animal forms.

Does: Describes Leonardo's obsession with the shapes and forms of living things.

The Movements of Water

Says: Leonardo was fascinated by the flow of water and studied its motion.

Does: Describes Leonardo's studies of fluid dynamics.

The Forms and Transformations of the Living Earth

Says: Leonardo made many geological observations and theories reflected in his drawings of plants and the land.

Does: Describes Leonardo's studies of the earth and landscape.

Macro- and Microcosm

Says: Leonardo's anatomical research was influenced by his studies of both macrocosm and microcosm systems.

Does: Describes the role of Leonardo's views on macrocosm and microcosm Leonardo's anatomical studies.

Nature's Mechanical Instruments

Says: Leonardo viewed human and animal bodies as mechanical systems.

Does: Describes Leonardo's studies into human and animal bodily mechanisms.

Leonardo's Machines

Says: Leonardo applied his knowledge of mechanics to his studies of machines.

Does: Describes Leonardo's many mechanical innovations.

The Dream of Flying

Says: Leonardo studied the mechanics behind bird flight in trying to make a flying machine.

Does: Describes Leonardo's studies into aerodynamics.

The Mystery of Human Life

Says: Leonardo used his understanding of fluid mechanics and careful observations to study the nature of life.

Does: Describes Leonardo's anatomic studies and embryological studies.

Section Seven - Geometry Done with Motion

Geometry Done with Motion

Says: Leonardo used mathematics to express his science.

Does: Describes the role of geometry in Leonardo's science.

Geometry and Algebra

Says: Leonardo used geometry to illustrate and design his art.

Does: Describes the role of geometry in Leonardo's works.

Drawings as Diagrams

Says: Leonardo drew observational pictures to replace mathematical diagrams

Does: Describes the role of scientific drawings in his study of math.

"On Transformations"

Says: Leonardo studied and practiced geometric transformations.

Does: Describes Leonardo's geometric studies of shape transformations.

Mapping of Curves and Curved Surfaces

Says: Leonardo tried to solve many classical problems involving curves and circles.

Does: Describes Leonardo's studies of curves and curved surfaces.

Curvilinear Transformations

Says: Leonardo used curvilinear transformations to experiment with a variety of shapes.

Does: Describes Leonardo's studies in curvilinear transformations.

Early Forms of Topology

Says: Leonardo was fascinated by numerous historical designs that involved topology.

Does: Describes the role of topology in Leonardo's studies.

De Ludo Geometrico

Says: Leonardo's work *De ludo geometrico* shows the cultivation of all his geometric studies.

Does: Describes the geometry shown in Leonardo's *De ludo geometrico*.

The Necessity of Nature's Forms

Says: Leonardo's saw the universe's physical relationships as "mathematical necessity".

Does: Describes and compares the view of math in Leonardo's times and modern times.

Section Eight - Pyramids of Light

Pyramids of Light

Says: Leonardo studied the process of observation itself.

Does: Describes Leonardo's studies on the science of sight.

The Science of Perspective

Says: Leonardo studied the mathematics of perception and optics.

Does: Describes Leonardo's studies of optics.

Light and Shadow

Says: Leonardo explored the role of perspective in the interplay of light and shadows.

Does: Describes Leonardo's studies of light in optics.

Optics and Astronomy

Says: Leonardo used his optical knowledge to study the sky.

Does: Describes the role of optics in Leonardo's studies in astronomy

The Nature of Light Rays

Says: Leonardo repeated numerous light ray experiments in studying the properties of light rays.

Does: Describes Leonardo's studies of light rays.

The Wave Nature of Light

Says: Leonardo speculated on the wave behaviour of light.

Does: Describes Leonardo's studies into the movement of light waves.

Sound Waves

Says: Leonardo explored the nature of sound through observation of musical instruments.

Does: Describes Leonardo's studies of sound waves.

Vision and the Eye

Says: Leonardo studied the anatomical eye and physiology of vision to better understand perspective and the interplay of light and shadow.

Does: Describes Leonardo's studies of the eye and vision.

Section Nine - The Eye, the Senses, and the Soul

The Eye, the Senses, and the Soul

Says: Leonardo studied the eye in trying to understand its connection with vision.

Does: Describes the reasoning behind Leonardo's anatomical experiments with the eye.

Leonardo's Anatomy of the Eye

Says: Leonardo studied the physical structure and mechanisms of the eye.

Does: Describes Leonardo's studies of the anatomy of the eye.

From the Optic Nerve to the Seat of the Soul

Says: Leonardo studied the connection between the eye and sensory perception.

Does: Describes Leonardo's studies of the eye in visual perception.

Hearing and the Other Senses

Says: Leonardo studied the production of sound in connection with the *senso comune*.

Does: Describes Leonardo's studies into auditory perception.

Cognition and the Soul

Says: Leonardo adopted the Greek view of the soul and connected it with his empirical studies.

Does: Describes Leonardo's studies of the connection between mind and body.

A Theory of Knowledge

Says: Leonardo developed a complicated theory of perception and knowledge based on his empirical evidence that could have revolutionized Western sciences.

Does: Describes the author's personal views on Leonardo's possible influence on Western sciences.

Epilogue

Says: The current world of science is developing similarly to Leonardo's vision.

Does: Summarizes the book's content and describes how Leonardo's studies can serve as inspiration for future scientific developments.