THE ART OF SCIENCE STORYTELLING

by

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For my Bertie

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ABSTRACT

The public notion that science must be strictly objective and documentaries must contain exact truth limits engagement in higher scientific topics important to human and environmental health. In order for people to believe scientific findings, they must trust those presenting the studies. A person's trust is not related to his or her education level, but to perceived values of the scientists themselves. This occurrence affects not just scientific studies, but nonfiction films and literature, as well. To understand this phenomenon of scientific distrust, I studied successful nonfiction films and literature, as discussed in the body of the paper and case study. I produced a website to show how medical information and storytelling techniques can exist together. The site seeks to gather the Microtia community and dispel myths about this congenital deformity affecting hearing and ear development.

The popularity of documentaries opens a dialogue of scientific discussions among experts and laypeople, as long as a filmmaker's values align with viewers' values. When documentary filmmakers design captivating characters that viewers can easily relate to, the scientific message is clear. Authors and filmmakers promote positive social changes when communicating science through storytelling.

INTRODUCTION

My grandfather's favorite question is, "Have I ever told you this story?"

At this point in my life, he has already told me, but I sit back to listen again. He is a wonderful storyteller, always sharing a nugget of wisdom by the end of the tale. His stories read like "The Best Of" personal experiences. From an early age, I learned animal husbandry, mechanical operations, and history, not to mention interpersonal relationships and general morality. Grandpa traveled extensively across the world for his career as an Agricultural Economist with the US Bureau of Reclamation. He and Grandma lived in Brazil, Portugal, and the Cape Verde Islands. To this day, he will speak to the family in Portuguese and assume we can understand. I have yet to have a birthday call that doesn't open with him singing "Parabéns pra você…" Grandpa is well educated and stresses the importance of attending school. And even if you choose his rival University, he will still attend your graduation.

My personal connection to my grandfather helped me understand and believe in his stories. Lectures in school never had the same effect on me as hearing a story and having a conversation about the important principles. The humanities excel at teaching these skills, while hard science focuses on reasoning and didactic instruction. Anti-intellectual movements focused on vaccines, climate change, and GMOs abound. This distrust in science is wide-spread, yet difficult to understand. Continuing studies seek to recognize the mechanisms behind and consequences of this issue.

My goal in this paper is to explain that there is a way to share scientific information, especially in the documentary form, to general populations. The storytelling model operates well in fictional novels and films. Documentaries can follow principles of fiction filmmaking and connect audiences to a character while keeping the truth intact.

In an article titled "The Science of Science Communication," author Dan Kahan explains, "Public opinion on societal risks presents a disorienting spectacle…Never have human societies known so much about mitigating the dangers they face but agreed so little about what they collectively know (1)." The identity-protective cognition theory explains this phenomenon. The theory explores a person's rigid commitment to an idea, right or wrong, and explains how even educated minds tend to cling to identity over rationality.

This paper will review why our brains function best on storytelling through an examination of successful nonfiction films and written works that incorporate techniques common to fiction. Finally, I review my project "Microtia Memoirs," a website connecting people seeking information and reassurance about the congenital condition, Microtia. This condition affects ear development and hearing.

In the following section, we explore brain function and go deeper into the mechanisms behind suspicion of scientific findings. But first, a story.

THE SCIENCE OF STORYTELLING

Before oral and written language, humans shared stories. More than 30,000 years ago, ancient people took shelter in caves and documented their lives on stone walls. Neanderthals are known for being less than human, of low intelligence, and incapable of complex imagination. Yet recently, archeologists have discovered evidence of their culture: rituals, trinkets, even art. Some cave paintings are now attributed to Neanderthals.

As human language evolved, we told real and imagined stories. These are folklore, legends, and myths. These tales usually consist of a moral theme and are of regional interest. Humans today are familiar with *Snow White* (1930), *The Little Mermaid* (1989), and every story Disney made famous. In these stories, humans can perform impossible feats and animals can speak. We can ignore these contradictions to reality through a process Samuel Taylor Coleridge named "the willing suspension of disbelief." The phrase comes from Coleridge's *Biographia Literaria*, a work that is "…introductory to a statement of my principles in Politics, Religion, and Philosophy (Project Gutenberg)." Coleridge proposes that authors can add a bit of truth to their stories which will help the readers ignore any fantastic impossibility a tale contains.

Coleridge's poem "The Rime of the Ancient Mariner (1798)," begins with a sailor accosts two men who are hurrying to a wedding. He is desperate to explain to the gentlemen why he is carrying a dead albatross on his shoulders. This thrilling poem follows the mariner on a dangerous ocean voyage. He makes the selfish mistake of

shooting an albatross, and all hell breaks loose. The ship sinks and the sailors become cursed by underwater humanoid monsters. The mariner is saved but his curse is to carry the heavy bird and use his bad behavior as a lesson to others. Coleridge doesn't intend his audience to believe a person will physically carry around signs of his sins, and the audience accepts this as a metaphor. The mariner is a sad fellow and the wedding guests feel sorry for him. They silently listen to his entire, long account. His character can be found in people that readers have encountered in real life and they can easily empathize with the poor mariner. Readers have committed their own sins.

"The Rime" is naturally engaging. Neurologists have learned that our brains process the most information when imagining, telling, or listening to stories. Why this happens is still unexplained, though there are several study-based theories. One idea connects back to the ancient human practice of storytelling. In his book about brain function, author Kendall Haven describes:

> Extensive research has shown that, because of this eons-long dependence on story, human brains are literally evolutionarily hardwired to make sense, to think, to understand, and to remember in specific story terms and elements (Story Smart, 3).

Haven's book, *Story Smart: Using the Science of Story to Persuade, Influence, Inspire, and Teach*, reviews various neurological studies. He explains how brains process and create stories:

> Unconscious portions of our human brains process raw sensory input and pass it to intermediate processing areas of the brain. These areas (also in the unconscious portions of our brains) are the exact areas that are activated when humans create stories (Pinker 2000; Newquist 2004; Kotulak 1999) (29).

Haven calls the unconscious area of our brains the "Neural Story Net." A brain processes information in the simplest way that makes sense to it. If information is missing, each person's brain fills the gap with personal previous experience so the situation makes sense. Further explanation of the "NSN" involves story structures. Brains use stored information to make sense of new incoming information, which is why each person can interpret the same situation in varying ways. Even when listening to truthful stories, our minds will automatically fill in missing facts to satisfy logic. These mini brain stories come from "eons-long dependence on story," Haven explains.

The author crafts a voice for the book's narrator and uses metaphors to explain complex neurological functions: marathon runners drop off folders into large filing cabinets; Marines drop onto a beach ready to fight. Haven even creates scenarios with made up people and shares crafted stories from real people to make his points. This practice demonstrates Haven's point that stories motivate and inspire an audience. Yet a science storyteller cannot simply make up a tale. "No one ever stormed Washington over a pie chart," he cautions. "But using story elements activates an emotional involvement [that] is a necessary component of full engagement. Engagement creates focused mental attention (18)."

Psychologists back up Haven's explanations with scientific study. In *Unintended Thought*, authors James Uleman and John Bargh discuss psychological studies, but explain that while the studies are sound, results seem to conflict:

> Phenomenology suggests conflicting intuitions about the control of automatic processing. Automatic reactions come to us whether or not we want them, so they seem beyond control. But often they tell us exactly what to do, so we rely on them, thinking they are well controlled (69).

Figure 1. Portion of a OneSpotScience Infographic.

Because humans have been telling stories for so long, it is possible our current brain functions evolved to follow storytelling principles. It is also likely that prehistoric human brain operations prompted early hominids to draw on cave walls. This either/or question remains unanswered, though the scientists that know brains best continue to search for a solution. Conclusions from these studies can assist storytellers in crafting the best script, whether they tell a made-up story about a mariner hauling a dead bird or real fisherman catching king crab in Alaska.

The psychologists involved in these studies took great care in finding a hypothesis, studying humans, and reporting the outcomes. Legitimate science can be a frustrating process. The purpose of the scientific method is to prove or disprove a specific hypothesis. After the process is complete, it leads to a new hypothesis and the procedure continues.

To the public, this often looks like a contradiction: red wine is good/bad for you; you should/should not exercise before sleep; wear/don't wear a bra. New studies often

refute conclusions from previous studies, leaving laypeople confused and angry. Enter identity-protective cognition. Author Dan Kahan returns to explain in his article "The Expressive Rationality of Inaccurate Perceptions." Writes Kahan:

> In the case of identity-protective cognition, that goal is protection of one's status within an affinity group whose members share defining cultural commitments. Sometimes…positions on a disputed societal risk become conspicuously identified with membership in competing groups of this sort. In those circumstances, individuals can be expected to attend to information in a manner that promotes beliefs that signal their commitment to the position associated with their group (Sherman & Cohen, 2006; Kahan, 2015b).

A person's social group and value system have more to do with their beliefs than hard scientific fact. The disconnect between science and scientists cause a conflict that also appears in the documentary realm. Yet, just as writers of science fiction can add a bit of reality to their scripts, it is reasonable that documentarians add a little fantasy to their works.

Ongoing scientific studies aim to explain identity-protective cognition. Though the neurological progression is not fully understood, this theory explains what happened to an influential documentary filmmaker who garnered both political infamy and fierce fan dedication in a single film. The next section examines this and other documentary films promoting poetic narrative over objective truth.

THE TROUBLE WITH DOCUMENTARY

Audiences find a distinction between fiction and nonfiction works. As with scientific studies, the public believe documentaries to be absolute truth. They become shocked, even betrayed, when the not-so-truth is revealed.

In his documentary about early humans, *Cave of Forgotten Dreams* (2010), Werner Herzog follows archeologists through Chauvet cave in France. Deep inside the cave are paintings in ochre, made by early humans and possibly Neanderthals. At the foot of many drawings lie bones and teeth of extinct predators. Herzog muses about the hopes and dreams of these humans. "Of course," explains Herzog in an interview with Eric Ames, "we have no idea what the paintings mean to them. We can only take some educated guess by looking into cultures that were in a Stone Age existence until fairly recently…(Werner Herzog: Interviews, 174)."

Traveling through a dark, vastly unexplored cave sounds exciting and adventurous, and Herzog's lyrical narration creates a dream-like feeling. However, the archeologists in the film are keen to prove they are *not* Indiana Jones. Nicholas Conard, an archeologist on the project, explains in the film, "I think what's extremely important is that we realize that archeology today is not a heroic adventure with spades and picks, but high tech scientific work that's done with incredible detail (*Cave of Forgotten Dreams,* 2010)." When Ames asked if Herzog was frustrated by the experts, Herzog compliments the archaeologists. "…thank God there is a new generation of scientists who are very diligent in describing the status quo… (Werner Herzog: Interviews 176)."

Figure 2. Rhinoceri in Chavuet cave, France. Courtesy of Wikimedia Commons.

In a magazine for scientists, "Lithic technology," author Grant McCall echoes Herzog's explanation of his approach in *Cave*: "From an intellectual standpoint, Herzog recognizes one of the fundamental paradoxes inherent in rock art research…its actual significance, meanings, functions, associations, and contexts are seemingly beyond our reach (Lithic Technology)." McCall, a man of science, appreciates the story inside the facts, yet he notes "there are some minor factual inaccuracies and misrepresentations (62)." He does give Herzog some credit, however, as he continues: "Nevertheless, these mistakes are more than forgivable given the enormous value of this, and I might add, the same complaints could be leveled against many of my Paleolithic archaeologist colleagues (62)." McCall gives the filmmaker some leeway, but other filmmakers have not been excused so easily.

Documentary filmmaker Michael Moore encountered identity-protective cognition when his film *Roger & Me* premiered in 1989. In the film, Moore attempts to visit Roger Smith, CEO of GM. His efforts are unsuccessful, and he uses this point to further the film's message: Roger Smith is afraid to confront his responsibility for destroying Detroit's economy, as explained by Moore. Moore did speak with Smith, but the interview is not on camera. Though Michael Moore used accepted editing techniques to tell the story, critics who find fault with Moore's ideals attacked his use of these conventions.

Authors Thomas Benson and Brian Snee explain the dichotomy of reviews for *Roger & Me* (1989). "…early critics recognized Moore's innovative use of black comedy as a means of interjecting a notoriously staid art form – documentary – with an entertaining narrative…other film critics found Moore's departure from that genre's established conventions problematic (*Michael Moore and the Rhetoric of Documentary*, 29)." The authors continue, "In this regard, *Roger & Me* (1989) may best be analyzed as an interpretation of truth and history rather than an objective and balanced presentation of reality (32)."

Benson and Snee state the film's reception was heavily divided and use the thought behind the unnamed identity-protective cognition theory to say: "While many viewers found Moore's overarching political arguments persuasive, the film lost ground by not reconciling its formal attributes as satiric comedy with the necessities of documentary film as an agent of change (48)." Moore's work leads what these authors call the "wave of boundary-crossing documentaries appearing at the end of the Reagan decade (31)." Critics of the film argue Moore's editing choices manipulated the story

beyond believability. This argument rises from the critics' morals conflicting with Moore's personal beliefs, rather than the critics finding a problem with typical film editing techniques.

Author Carl Plantinga forgives Moore, much like McCall gave credence to Herzog's manipulations:

> Michael Moore had full knowledge of the discrepancies between representation and fact in his film…Even if Moore is deceptive, however, we may ask about the weight of these deceptions. Perhaps these "white lies" are forgivable in the light of the political benefits the film brings… Those who agree with the film's politics forgive them, whereas those unsympathetic to Moore tend to exaggerate their importance (95).

Because Moore turned into a character in the film, his own claims were a reason for people to question the truth. Platinga explains objectivity and its relation to film: "Concepts such as objectivity, fairness, impartiality, and balance need not be reduced to absolute terms. If we think of objectivity as that which lacks perspective, there can (of course) be no objectivity, because every representation is from a perspective (212)." This is where film deviates from scientific method toward the broad realm of art. Skepticism against objective truth comes when those presenting the facts go against a viewer's personal belief system.

A shared public notion is that historic films are more accurate than today's mix of truth and story, yet documentaries of the past utilized the same fictional elements found in modern films. Even after evidence and common knowledge that *Nanook of the North* (1946) is completely simulated, critics and audiences look to this film as a prime example of documentary filmmaking. Robert Flaherty, the film's director, seems ignorant and

oppressive at first blush, but Alan Marcus explains the film's success in his article "*Nanook of the North* as a Primal Drama."

> In order to explore the theme of survival, Flaherty was not content with the praxis of hiring actors and shooting on a set. Rather he took his camera to a distant environment and trained an indigenous cast of non-actors and technicians to assist him in crafting the narrative and devising scenes closely drawn from their personal experiences (203).

Nanook deviates from the truth in cases where modern technology replaced primitive practices shown in the film, but the overall themes of survival and family values shine when shown in this context. These themes are relevant to audiences no matter which of Nanook's daughters-in-law happen to be playing his wife. Flaherty places audience connection to character higher than cultural accuracy. "What Flaherty wanted to avoid was a film based strictly on observational techniques which failed to engage the viewer (207)," Marcus explains. "What he did aim to achieve was a drama featuring conflict and resolution, a drama of survival and of characters who, by endearing themselves to the audience, would be viewed as fun-loving, resourceful, and even exemplary (207)." Flaherty's depiction shares a universal truth about humans in any culture through poetry and symbolism.

Just as *Birth of a Nation* (1915) is a long-standing example of great cinematography and editing, the vast history of early documentaries follow the narrative form, whether or not the plot is racist. In modern films, filmmakers will face scrutiny when presenting facts creatively as information increasingly becomes available to the masses. This history seems daunting, yet there are examples of well-told stories of that prove truth and entertainment can exist together. We will discover this concept as found in literature in the next section.

CREATIVE TRUTH IN NONFICTION STORYTELLING

Joseph Conrad wrote *Heart of Darkness* as an allegory, so readers can adapt the novel's principles to fit their imagination. The willing suspension of disbelief is appropriate for fiction films, but these elements can be utilized in scientific stories without compromising facts. This section examines works from three nonfiction authors who proficiently blend storytelling and science, and connect us to the human characters in their works.

Rachel Carson begins her scientific work *Silent Spring* with a story. Chapter One, titled "A Fable for Tomorrow," tells the dismal story of a fictional town. Once a beautiful place, a "blight" sweeps the area and everything is still. She reveals at the end that "no witchcraft, no enemy action has silenced the rebirth of new life in the stricken world. The people had done it themselves (3)." Carson explains her story is fabricated, but environmental problems encountered in the town plagued actual cities across the world. This explanation and following factual examples assist the reader to believe this dangerous fantasy is becoming a sad reality.

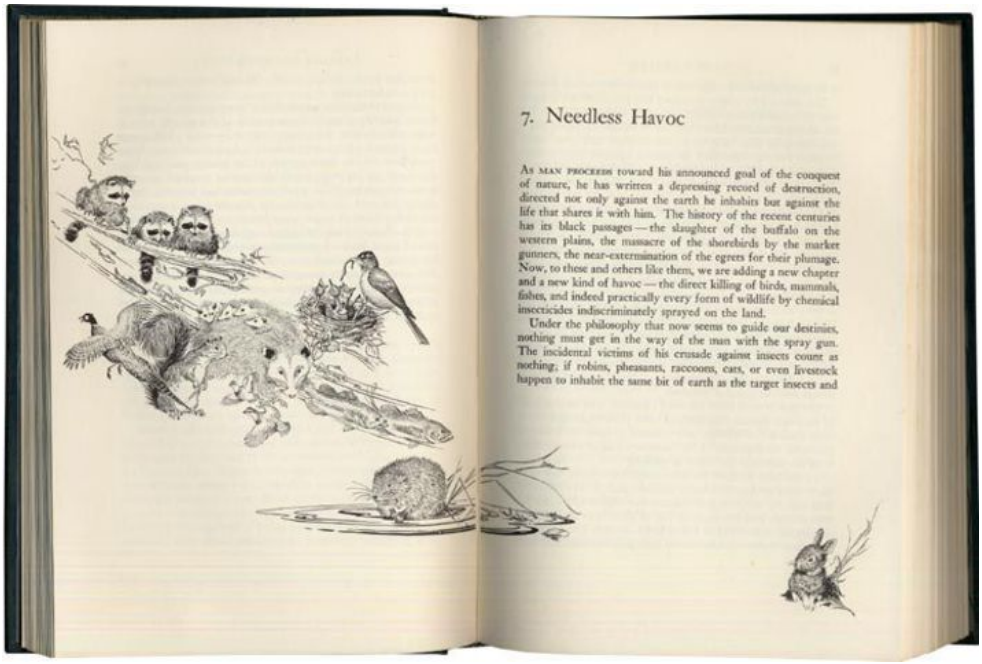
Dramatic chapter titles such as "Elixirs of Death" and "Nature Fights Back" introduce complex scientific concepts by drawing in the audience to the tragedy of the pesticide DDT. She compares the insecticide to the Medea's magical cloak in the ancient myth Jason and the Argonauts. Medea's magical cloak is likened to a garment soaked in insecticide; such a cloak would have killed Jason as readily as any supernatural power.

Unique, detailed line drawings accompany each chapter heading, continuing the fairy-tale feeling presented in the opening fable. The last chapter, titled "The Other Road," reminds readers

> We stand now where two roads diverge. But unlike the roads in Robert Frost's familiar poem, they are not equally fair. The road we have long been traveling is deceptively easy…but at its end lies disaster. The other fork of the road–the one "less traveled by"–offers our last, our only chance to reach a destination that assures the preservation of the earth (277).

To Carson, poetry is as important as fact when describing environmental and health risk. The striking imagery and spectacular diction work in harmony with explanations of fact and history. "Darwin himself could scarcely have found a better example of the operation of natural selection than is provided by the way the mechanism of [insect] resistance [to chemical pesticides] operates…(272-273)."

Carson describes a grocery store as "homey and cheerful, and, with the pickles and olives across the aisle and the bath and laundry soaps adjoining, rows upon rows of insecticides are displayed …Use of poisons in the kitchen is made both attractive and easy (174)." Though consumers were ignorant of chemical dangers, contemporary society abides by laws designed to protect consumers and the environment. Even so, the powerful message throughout *Silent Spring* is clear: the damage is done. Humans solved past public health issues through technology, but the same human-centered technological advances against nature have come back to haunt us. The language and imagery in *Silent Spring* reinforces Carson's meaning.



7. Needless Havoc

As man proceeds toward his announced goal of the conquest of nature, he has written a depressing record of destruction, directed not only against the earth he inhabits but against the life that shares it with him. The history of the recent centuries has its black passages — the slaughter of the buffalo on the western plains, the massacre of the shorebirds by the market gunners, the near-extermination of the egrets for their plumage. Now, to these and others like them, we are adding a new chapter and a new kind of havoc — the direct killing of birds, mammals, fishes, and indeed practically every form of wildlife by chemical insecticides indiscriminately sprayed on the land.

Under the philosophy that now seems to guide our destinies, nothing must get in the way of the man with the spray gun. The incidental victims of his crusade against insects count as nothing; if robins, pheasants, raccoons, cats, or even livestock happen to inhabit the same bit of earth as the target insects and

Figure 3. Chapter 7 heading of *Silent Spring*.

Carson's work sparked controversy among government and citizens over the use of DDT. "In the years around and after 1970," writes Jushal Shah in the Indiana University Journal of Undergraduate Research, "*Silent Spring*'s direct influence became evident in the growing campaign against DDT, a topic on which more and more articles were written (20)." Post WWII outrage against widespread use of DDT fit in well with other environmental and antigovernment movements growing in America.

In an article featured on the Chemical Heritage Foundation's website, author Elena Conis explores the complicated history of DDT. "We simplify the pesticide's story because that stripped-down version of DDT's history buttresses our understanding of the past (Chemical Heritage Foundation)." Her article chronicles the use of DDT as a control for human disease and crop pestilence at home and abroad, as part of the war effort. "The

public's acceptance of the chemical captures American postwar faith in scientific expertise. And its vilification by environmentalists serves as a powerful and lasting illustration of the baby boomer generation's antiauthoritarian turn (Chemical Heritage Foundation)."

Conis' expressive language influences readers much like scripted dialogue in fiction film scripts. She cites scientific studies but describes the chemical as a character in her article: "But what happens if we tell DDT's story differently," she questions the reader. "This story shows that many Americans needed to be convinced that DDT was a technology worth adapting to peacetime use. And this story calls into question the claim that the nation wholeheartedly accepted DDT (Chemical Heritage Foundation)." Used widely by farmers and home gardeners, DDT effectively destroyed pests, but the War Production Board, National Institutes of Health, and the Food and Drug Administration warned of potential harmful effects. Despite studies by these institutions, no clear outcome could rate the harm of DDT. As with modern studies that seemingly contradict one another, studies on DDT could not explain detrimental effects. "If DDT was harmful to humans, the methods by which it worked its harm were no clearer in peace than in combat. If anything, as time passed, DDT's safety seemed to be unprecedented (Chemical Heritage Foundation)."

Rachel Carson wrote *Silent Spring* to describe the damaging effect to humans and the environment by overuse of the dangerous chemical. Her book added to the growing concern voiced by the public and local government offices. In the beginning, federal government offices and chemical companies resisted accusations and criticized Carson's conclusions, but the overwhelming response to the book directly affected change.

"Picked up and amplified through government, academia, and industry, [*Silent Spring's*] message has brought about a number of important changes (267)," writes Frank Graham Jr. in his book, *Since Silent Spring*. "Though spokesmen for the agri-chemical industry distorted [Carson's] message by implying that it led only to the surrender of the earth to noxious insects, she has been vindicated as more practical than the hard-headed businessmen (270)," Graham provides a bulleted list of these changes which include:

> …procedures were improved by USDA for registering chemical pesticides, and by FDA for determining the maximum pesticide residues to be permitted in food and drink…*Silent Spring* was the beginning of that crusade which persuaded administrators and legislators alike that the chemical industry would not act in the public interest unless forced to by stricter regulations (267).

Federal offices and chemical companies resisted these criticisms in the wake of *Silent Spring*, but soon "…the [USDA] department reduced the dosage to one and a quarter pounds per acre, and then to one-quarter pound per acre, spaced at intervals of three to six months (Graham 227)." Fifty-five years later, the USDA monitors for overuse of chemicals harmful to humans and the environment. Graham concludes, "It has been only since the publication of *Silent Spring*, for instance, that the decision-makers at USDA came to appreciate fully the implications of both insect resistance and pesticide residues (270)."

Written in the early stages of environmentalist movements, *Silent Spring* became an anthem and continues to be an important work. Nearly fifty years later, a new nonfiction novel rocked a different boat.

The *Immortal Life of Henrietta Lacks* explores the tangled world of medical patents. Following the events of this real-life story, author Rebecca Skloot interviews

scientists, lawmakers, and family members in the quest to understand the history behind the most infamous case of cancer research.

Henrietta Lacks was a poor black woman living in Virginia. In 1951, she visited Johns Hopkins hospital in Maryland with abdominal pain and found she was pregnant. After the baby was born, Henrietta continued to have unbearable pain. During her treatment, doctors sampled cancerous and healthy tissue. Surprisingly, the cancer cells continued to replicate quickly and survived longer than a few days. Because scientists can study these remarkable cells, cancer pharmaceuticals are more effective. Unfortunately, Henrietta died without knowing her cells would save many lives.

Doctors at Johns Hopkins were so awed by Lacks' strange cancer cells they kept samples and performed tests, all without telling Lacks or asking her permission. Today, doctors follow informed consent ethics to explain to the patient as best as possible the risks and benefits of surgical procedures, drug trials, and medical studies. The complicated nature of medicine requires highly educated specialists who must explain intricacies to patients. Informed consent is the goal; however, it is difficult to be sure a patient completely understands. In scientific studies, participant information is made public, with great care taken to keep individual identities private. Authors Henry Greely and Mildred Cho elaborate, "Some [human samples and data sets] come with no consent, some have some consent, but few have actual and honest informed consent to be used for any purpose by any researchers or for data to be publicly available online (849)." Informed consent was required for experiments in the late 1940s after the Nuremberg trials uncovered illegal research performed on unwilling human subjects, but informed

consent for general healthcare did not become law until 1962 (National Institutes of Health)."

Skloot stirred new discussion about informed consent in her book. She compares writing to science, explaining that "good science is all about following the data as it shows up and letting yourself be proven wrong and letting everything change while you're working on it, and I think writing is the same way (*Rebecca Skloot The Immortal Life Comments*)." The scientific method is considered objective, despite potential error because scientists are human. Authors experience greater leeway, but Skloot holds herself as responsible as any scientist sharing her discoveries.

Henrietta Lacks was reduced to the simple nickname HeLa, the code identifying her cancerous cells. Skloot weaves together the forgotten pieces of Lacks' life through interviews with her surviving family. One element of the story is her tragic life and miserable death. Another is her mysterious and scientifically staggering cancer which continues to generate. The third is the disturbing history of protected health information, which was only recently protected, and a philosophic examination of a person's rights to their own body parts. The book is broken into three parts, ordered chronologically, but each element appears in sections as they relate to the Lacks and HeLa timeline.

The book reads like a historical fiction, where events may or may not be creatively interpreted. However, Skloot makes it clear from the beginning, "This is a work of nonfiction. No names have been changed, no characters invented, no events fabricated (xii)." Though they all exist in real life, Skloot has an appendix called "Cast of Characters," in the style of old mystery novels. The "Reading Group Guide" offers

questions for discussion, a section shared by textbooks and Oprah's Book Club list of fictional novels.

Throughout the book, Skloot gives insight into her own journey from a scared young white girl to a trusted journalist who actively helped the Lacks family by publishing the unknown story. Because of HeLa, incredible medical advancements were possible, but Henrietta's family remained in poverty while researchers profited. In an interview on her website, Skloot explains the book is "…a story about family…while at the same time you're learning that you actually benefited from [the Lack family's] mother's death (Rebecca Skloot The Immortal Life Comments)." Skloot expertly leads the reader through this struggle between such diverse outcomes. "The origin of these cells, although never a secret, did not become well known until the 2010 publication of Rebecca Skloot's book…(Greely & Cho 849)."

Lacks' cells continue to grow and continue to be valuable to cancer research. In the Afterward, Skloot sums up the most important points in this complicated story. She describes court precedents involving human tissue research and the outcomes which still leave the situation unclear. "Despite all the other cases and the press they've received, the Lacks family has never actually tried to sue anyone over the HeLa cells…in theory, the Lacks family might be able to withdraw HeLa cells from all research worldwide…Every researcher I've mentioned that idea to shudders at the thought of it (328)."

The National Institutes of Health (NIH) are in control of the HeLa cells. Only recently, in 2012, did the NIH "[reach] an understanding with the [Lacks] family…(The Henrietta Lacks Legacy Grows). The NIH article continues,

> These cells have already been used extensively in scientific research and have helped make possible some of the most important medical advances of the past 60 years. Access to the whole genome data of these cells will be a valuable reference tool for researchers using HeLa cells in their research (National Institutes of Health).

Greely and Cho remark, "We think these acts…show an understanding of the underlying interests that researchers and research participants share (840)."

Without questioning science or personal motives of researchers and doctors, Skloot forced change through her captivating story. The only villains in this chronicle are cancer cells. Skloot did not compromise facts or individuals, but allowed fascinating characters to drive her points home. She explains how her crafted story of true events invites people in, even when they normally would not read a science book. "The greatest responses that I get to the book usually starts with 'I hate science…but then I couldn't stop,'" Skloot explains in her interview. "And a lot of what brings them to the story is the characters (Rebecca Skloot The Immortal Life Comments)."

Skloot is not a scientist, but a "science writer" as described in her "About the Author" page. David Quammen, another modern nonfiction writer, shares this distinction. These authors, trained in storytelling, use their skills to engage the public in science topics that may otherwise be complicated for a layperson. "Of course," Dan Kahan informs us, "because most people aren't in a position to evaluate technical data for themselves, they tend to follow the lead of credible experts (1)." The identity-protective cognition theory leads amateurs to follow the experts "whom they perceive to share their values (1)." Skloot and Quammen are relatable authors, so it is easy for the reader to believe the information.

With an extensive background in magazine article writing, David Quammen's science stories are digestible tidbits about biology, history, and the human experience. Using first-person narration, Quammen successfully draws the reader into the moment. His quick wit and clever asides relax the reader into daunting topics. He compares the life of the "self-educated Mississippi crank" William Faulkner and the nautilus, a living fossil (Flight 261)." He dislikes all the math involved in science and warns his readers about difficult equations they are about to encounter, in case the reader wants to skip ahead.

Though his writing is for non-experts, he does not use simple language or dumb down the concepts. Several of his articles and a novel discuss evolutionary theory, history, and species extinction. *Song of the Dodo: Island Biogeography in An Age of Extinction* follows Quammen as he travels in the footsteps of Charles Darwin and Alfred Russell Wallace across the Galapagos, Mauritius, and Komodo islands. One chapter finds Quammen on a rocky beach of the Galapagos, near the site where Darwin rode giant tortoises and repeatedly tossed the same iguana into the sea.

Figure 4. An artist's rendering of an aged Darwin's Galapagos adventures on Natural Habitat Adventures' "About Galapagos" website.

Quammen shares a statement about the marine iguanas Darwin noted in his journal, "'It is a hideous-looking creature, of a dirty black color, stupid, and sluggish in its movements,' Darwin wrote. Here I think he was a little unfair," Quammen remarks. In his travels Quammen encountered these same creatures, the only marine lizards in the world. "The iguanas I'm watching this morning stand aloof from that scientific conundrum (166)."

In his travels, Quammen seeks to understand why island species are so fragile. Though it may sound tedious, Quammen encourages his readers. "If this sounds purely sober and recondite," he writes on his website, "please don't be misled. As I say at the start of the book: 'Island biogeography, I'm happy to report, is full of cheap thrills (David Quammen, Other Books).'" Quammen describes his injuries and dangerous moments. These experiences are similar to Alfred Russell Wallace's history: he contracted malaria and sustained several large wounds that were not properly treated in the jungle. These injuries plagued him for the rest of his life. Quammen is aware of his position as a writer, and honors the ecologists of the past and present. The story of the dodo's extinction mirrors current efforts to protect endangered species like crocodiles and Komodo dragons.

Not limited to a specific area of study, Quammen is free to write about deserts, swamps, or islands. In each book or article, readers learn the sociopolitical and ecological history of exotic locations around the world and in the US. The thread throughout the range of topics is meeting a compelling real-life character who guides readers through the

gateway into a historic story. Like Michael Moore, Quammen becomes a character in his own stories, and creates interesting personalities out of factual scientists.

Heraclitus, also denoted a "crank" by our author, uttered the famous phrase, "you can't step in the same river twice." In a story that begins with Heraclitus, Quammen actually steps in the same river twice: when fly fishing with good friends, and again after the friends divorced. Included among personal anecdotes are science facts behind why his spot is perfect for fly fishing: a trout's favorite insect *P. californica*, and stenothermals that keep the river nearly the same temperature year-round.

Most articles in Quammen's collection of magazine articles are titled or mention time. These stories easily compare past and current issues faced by modern humans. Sometimes the historic issue caused the current one, as in *Silent Spring*. Sometimes real experience functions as an allegory, like *Heart of Darkness*. These principles can move from writing to the screen easily, as we will discover in the following Case Study film that combines natural history and personal narrative.

CASE STUDY: *PEOPLE OF THE SEAL* (2009)

As with Quammen's adventures, the film *People of the Seal* (2009) is a framework story where historic, cultural, and environmental issues are told through the experience of one person looking back in time.

The National Oceanic and Atmospheric Administration (NOAA) produced this film that combines science and story. The film opens with rhythmic drumming and chanting. Like a creation tale, the narrator explains this story "belongs to our place as opposed to belonging to any one person." Before the audience understands who is speaking or where the story takes place, the narrator continues "It doesn't begin with 'Once Upon a Time.' It begins with the phrase 'Tanam Awaa,' and Tanam Awaa means 'our country's work (*People of the Seal* (2009).'" As in *Silent Spring*, a mystery draws viewers into the true story.

People of the Seal (2009) is a science story that connects the Aleutian Island natives to fur seals. Like the seals, the Ununga people are threatened, poorly treated, and ruled by various countries and politics. A small town on a small island lived and died by the fur seal industry which ended in 1983. One cannot separate the history of the people from the history of the animals. Revealed as Aquilina Lestenkof, the narrator explains, "who we are weaves together at least three very different traditions. Ours is a story of survival, of adaptation, and a constant threat of extinction." Aquilina gives a personal perspective on large historical and continuing issues. "Someone once said that the

Pribilof Islands are a microcosm," Aquilina continues. "This is a place where we can look at human interactions with the planet in general."

The first-person narration helps audiences connect to the indigenous people and animals of the Pribilof Islands. The native people have a strong sense of identity in their community and heritage, but the future of the culture is uncertain due to the past actions of other humans. After the introduction to the land and people, Aquilina explains fur seal behavior and migratory patterns. "Right now, it's fall. The children are back at school, and the fur seal pups are in swimming school…When they come home, you're home, too."

Figure 5. Aquilina Lestenkof teaching children in a photo from Alaska Public Media.

As in traditional science films, included talking head interviews with archeologists and historians explore the ancient cultural practices of the Ununga People. Scientists cannot ask Neanderthals what they were really thinking when painting cave walls, but the Ununga people are able to share their own stories. Like poetry and science meeting *in Silent Spring*, *People of the Seal* (2009) gives voice to native leaders as well

as outside scientists. Through the narration, viewers learn facts from archeological findings: Russians killed the natives until barely thousands were left. The Russians used the Ununga belief in a deity, love of music, and communion with nature to convert them to the Orthodox ways. “How do you have a piece of history be known and be told without making the next generation angry?” Aquilina asks her audience. She does not directly answer the question, but through her actions viewers learn how her family looks up to her example. The native Ununganss speak for themselves, with supporting statements provided by scientists. These outsiders are limited in screen time. Aquilina actively keeps her culture alive by teaching her children the Unangam Tunuu language, Ununga practices, and the meaning behind her facial tattoos.

Both *People of the Seal* (2009) and *Nanook of the North* (1946) follow northern native tribes, though *People* allows the natives to share their own true story. In a book guiding archaeologists through the process of documentary filmmaking, the writing/filmmaking team Peter Pepe and Joseph Zarynski describe *Nanook of the North* (1946) as “…a rather romantic depiction of indigenous people pitted against the harsh environment of the Canadian subarctic region (Documentary Filmmaking for Archeologists, 25).” Authors temper criticisms of the film “not being a truth ethnographic record of Inuit society (27)” by explaining that Robert Flaherty spent enough time living with the natives that he understood their culture and he knowingly made narrative decisions that conflicted with modern truth but told a great story. Aquilina makes a perfect character because she is part of the culture she describes.

After natives and experts explained the science, *People of the Seal* (2009) returns to the narrator weaving a basket next to the sea. “I think about the layer upon layer of people’s passages here on this island,” Aquilina muses. “And the next basket we weave? Well, it’s going to have a bit of each one of those interactions…You just keep things going through time for coming generations that we don’t see yet.” As Aquilina speaks, the rhythmic drumming returns to punctuate her story. *People of the Seal* (2009) is a personal narrative story, one that cannot be told without including nature.

Personal histories make each of us unique, yet individuals in similar circumstances can relate to common experiences. Next, I discuss my project, *Microtia Memoirs*, a personal history turned into a scientific information source.

MICROTIA MEMOIRS

Microtia is a congenital condition that affects ear development and hearing. Because of the rarity of Microtia, many people never meet anyone else with this condition. Feelings of isolation and speculative information trouble the community.

Instead of a traditional documentary, “Microtia Memoirs” uses multimedia elements to combine science and story. Documentaries must keep up with modern audience needs. Laypeople may not understand Microtia, but they are familiar with emerging technology. Microtia is a difficult topic to address, because while scientific studies on physiology and cause abound, much of the information is inconclusive. There is no central location for information on this condition, and even among surgical websites, the data is not precise. More accurate than a documentary film, my website contains the latest information in a variety of visual formats to help users to understand the condition. Information can be updated quickly as studies discover more about Microtia and as technology advances.

Microtia Memoirs features a home page that introduces users to basic and emerging information. Melissa Lundquist is my sister and the web developer. She also has Microtia. Her experiences give the site exclusive insight and background. My site seeks to connect people with Microtia and combat misinformation. This story does not follow Melissa’s personal experience exactly, but contains information relatable to users with and without Microtia.

Instead of a static film, a webpage is a living document, operating at a faster level of user engagement. This engagement affects the construction of the website, which is part of my storytelling. The bilateral split of images on the site mimics the nature of Microtia, where usually only one side is affected, the other ear presenting typically. The landing page, the first page a user encounters, features a parallax scroll. Users do not have to navigate away from initial information to continue learning. Color theory prompted the yellow-blue design across the site. These opposite colors promote a professional look with a friendly, inviting feeling. Distorted images and mixed color turn into typical images and balanced color as the user continues to scroll and learn.

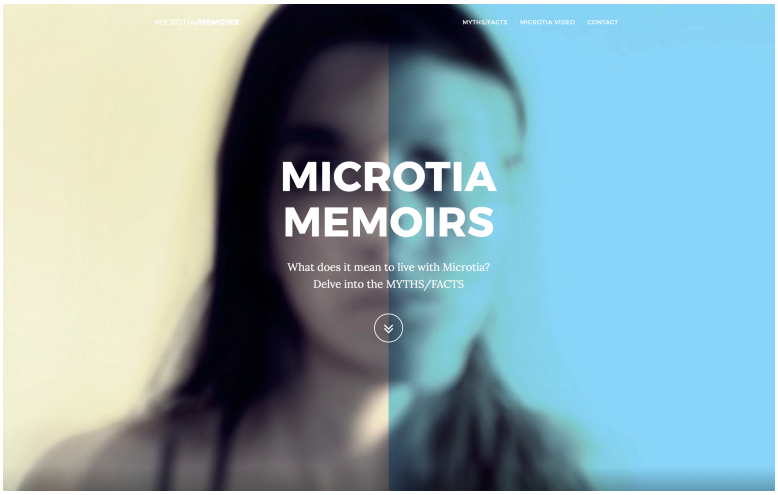


Figure 6. Screenshot of landing page: www.microtiamemoirs.com

I created a short video that shares tips on basic communication skills relevant to any conversation. Many hearing people become nervous when interacting with people who have hearing impairment. This video is light-hearted and educational, providing helpful information in friendly manner. The attitude of the video differs from standard "Step 1, Step 2" format of scientific training, which can be not only boring, but off-

putting. Actors in the video enact seven scenarios the correct and incorrect way. Both scenarios appear side by side and play at the same time, following the bilateral split featured elsewhere on the site.

Two 360° videos are accessible on a supplementary page. Users can view these videos in multiple ways: on a smartphone, with or without a virtual reality headset; or on a computer using mouse clicks to navigate the videos. The videos have little or no live action and rely on sound design to immerse hearing users into a hearing-impaired experience. In one video, viewers are in a home environment. First, a sound scenario featuring household noises plays while users get used to the 360° environment. After the sound scene plays, the same sound scenario repeats, only this time the typical household sounds are distorted. The sounds come through only one speaker, white noise filling the opposite side. This disorienting soundscape with no visual hints mimics the experience a person with one-sided hearing encounters daily. The second 360° video takes place in a library. In this scene, the entire soundscape is one-sided and confusing. White noise and fluorescent light buzz drowns out other sounds, making it difficult to interpret the scene.

I decided on the 360° format in order to immerse users. In a virtual reality headset, users can escape into a world where normal vision and hearing are replaced by the created video. Simply using a headset can disorient viewers. A person with Microtia has a hard time distinguishing voices from distracting background noise, even in a place as quiet as a library. Whispered voices are difficult to understand among unusually loud standard sounds such as clock ticks and fluorescent light buzz. Each person with hearing

impairment will have a slightly different experience, and so will hearing users experiencing the videos.

Though I staged and edited all three videos, they still are as documentary works. None of the actors are hearing impaired and the sound design was developed by myself, a hearing person, yet these events were recreated from descriptions and stories provided by hearing impaired people. They are designed to relate experiences in a realistic way. I did not distort sound to deceive users, but used the sound to inform and include viewers in a unique way. These scenes could be criticized for including fictional and manipulated elements, however, they are a clear example of the emerging documentary style balancing fact and fiction.

CONCLUSION

Human stories date back to pictures drawn on cave walls. These paintings evolved into speech, and eventually turned into books and films. Poetry is also an effective storytelling form. “The Rime of Ancient Mariner” (1798) is an allegory that connects readers to a relatable person, and warns them to avoid selfish actions. Stories share archetypes of good and evil, love and war through both real and imagined characters. *Nanook of the North* (1946) became a classic film, not from a dedication to literal events, but inclusion of the universal themes of human life. A modern story about nomadic life in the far north, *People of the Seal* (2009) also communicates themes of survival and culture. This natural history film could have focused on the story of Northern fur seals, but instead, a human narrator leads the audience through seal’s lives as well as her own. By including her personal information, viewers understand a global story where separation of seals and people would miss important truths.

From ripped-from-the-headlines crime dramas, characters speaking directly to the audience, and scripted Reality TV, fiction films draw on truth and documentary techniques regularly. Conversely, documentary filmmakers usually attract criticism when applying fiction rules to their stories. This problem stems from the identity-protective cognition theory which explains that a person will only believe facts offered by people who abide by their own principles.

The process of storytelling links to our brain functions. The human brain is physically wired to imagine, tell, and listen to stories. Brains catalogue information in

story-like structures to interpret events. The brain also functions to cover the gap of missing details, creating mini stories multiple times a day. For reasons still under analysis by scientists, facts presented in story form make more sense to human brains. These studies assess the role of brain function in imagination to explain why stories mean so much to us.

The scientific process begins with a hypothesis and continues through objective examination of observed data. Objectivity may be affected by human error or bias, but the public believes in the impartiality of the scientific method. While scientists are held to a strict standard, filmmakers can take advantage of viewers' familiarity with storytelling to share their data creatively. Documentaries adopt the science of storytelling to convey truth in a way the audience will understand and accept.

Documentary filmmakers past and present face criticism when their stories move too far from audience values and perspectives. There is a science behind storytelling, and personal experiences make the best tales. The most effective impact of storytelling is that a great story develops a connection to viewers. Reception of a film's message relates to how the audience views the filmmaker's personal tenets. Documentary filmmakers can tap into the identity-protective cognition theory to choose the right audience for their message, which will produce long-lasting influences on audiences. Michael Moore and Wener Herzog have met success, if unintentionally, by following this philosophy. Both directors appeared as characters in their own films. This allows viewers to identify with a person, making it easier for these filmmakers to present their facts in a way the audience will accept.

Nonfiction novels can also effectively borrow from fiction. As I discussed, authors like Quammen, Carson, and Skloot show that engaging stories about real people and events are as exciting as fiction, with the added benefit of evidence and truth. Because these authors are relatable to their audience, readers easily understand the message. Changes in environmental law, healthcare privacy, and endangered species protection resulted directly from reader actions following the publications of some of these nonfiction stories.

Following successful examples of filmmakers and writers, I designed a project to combine medical information with personal history. “Microtia Memoirs” explains not only the congenital condition Microtia, but connects a unique community. My site hosts scientific studies, personal experiences, and experimental resources in one location. My sister, Melissa, has the condition explained on the site and she functions as a character. Her authenticity is believable, so users are more likely to trust the information we present.

Effective learning comes through personal, emotional stories. Criticisms of documentary should not discourage creativity in storytelling, but entice filmmakers to provide transparency and direct their message through interesting, relatable characters.

REFERENCES CITED

Alan Marcus (2006) *Nanook of the North as Primal Drama*, Visual Anthropology, 19:3-4, 201-222, DOI: 10.1080/08949460600656543

Ames, Eric, ed. *Werner Herzog: Interviews*. Jackson: U Press of Mississippi, 2015. Print.

Benson, Thomas W., and Brian J. Snee. *Michael Moore and the Rhetoric of Documentary*. Carbondale, IL: Southern Illinois U Press, 2015. Print.

"Beyond Silent Spring: An Alternate History of DDT." *Chemical Heritage Foundation*. N.p., 14 Feb. 2017. Web. 27 Mar. 2017.

Birth of A Nation. Dir. D. W. Griffith. Perf. Lillian Gish. Kartes Productions, 1914. DVD.

Carson, Rachel Louise. *Silent Spring*. London: Hamish Hamilton, 1962. Print

Cave of Forgotten Dreams. Dir. Werner Herzog. Creative Differences, History Films, Ministère de la Culture et de la Communication, 2010.

Coleridge, Samuel T. *Biographia Literaria*. Project Gutenberg, n.d. Web. 11 Nov. 2016.

Coleridge, Samuel Taylor. *The Rime of the ancient Mariner and Other Poems*. New York: Dover, 1992. Print.

Graham, Frank, Jr. *Since 'Silent Spring.'* London: Hamilton, 1970. Print. 4th Printing.

Grant McCall (2012). *Cave of Forgotten Dreams* (film) Directed by Werner Herzog, Lithic Technology, 37:1, 61-62, DOI: 10.1179/lit.2012.37.1.61

Greely, Henry T., and Mildred K. Cho. "The Henrietta Lacks Legacy Grows." *European Molecular Biology Organization* 14.10 (2013): 849. Web.

Haven, Kendall F. *Story Smart: Using the Science of Story to Persuade, Influence, Inspire, and Teach.* Santa Barbara, CA: Libraries Unlimited, 2014. Print.

Kahan, Dan M. "The Expressive Rationality of Inaccurate Perceptions." Behavioral and Brain Sciences 40 (2015): n. pag. Web.

Kahan, D. “Fixing the Communications Failure.” Nature 463, 296-297 (2010)

Kahan, Dan M. "The Science of Science Communication." Journal of Science Communication, 14(3), 1-10 (2015) Yale Law School, Public Law Research Paper No. 539.

The Little Mermaid. Prod. Walt Disney. Buena Vista Pictures Distribution, Inc, 1989. Videocassette.

Lundquist, Melissa, and Lindsay Hadfield. *Microtia Memoirs*. N.p., 1 Mar. 2017. Web.

Nanook of the North. Dir. Robert Flaherty. National Film and Video Center, 1946. DVD.

National Institutes of Health. Ed. Joel Sparks. U.S. Department of Health and Human Services, n.d. Web. 02 Apr. 2017. <https://history.nih.gov/about/timelines_laws_human.html>.

"NIH, “Lacks family reach understanding to share genomic data of HeLa cells.” National Institutes of Health. U.S. Department of Health and Human Services, 15 Sept. 2015. Web. 01 Apr. 2017.

"Other books." David Quammen fiction and non-fictions science writer. Author of Spillover: Animal Infections and the Next Human Pandemic. N.p., n.d. Web. 02 Nov. 2017. <http://www.davidquammen.com/other-books>.

People of the Seal. By John A. Lindsay, Kate Raisz, Aquilina Lestenkof. NOAA Ocean Media Center, 2009. DVD.

Pepe, Peter, and Joseph W. Zarzynski. *Documentary Filmmaking for Archaeologists*. Walnut Creek, CA: Left Coast, 2012. Print.

Rebecca Skloot The Immortal Life Comments. N.p., n.d. Web. 27 Mar. 2017. <http://rebeccaskloot.com/the-immortal-life/>.

Quammen, David. *The Flight of the Iguana: A Sidelong View of Science and Nature*. New York: Scribner, 2004. Print.

Quammen, David. *The Song of the Dodo: Island Biogeography in an Age of Extinctions*. New York: Simon & Schuster, 1996. Print.

Roger & Me. Dir. Michael Moore. Dog Eat Dog Films, 1989. DVD.

Shah, Kushal S. "Silent Spring and The New York Times: How Rachel Carson Won the Journey." Indiana University Journal of Undergraduate Research1 (2015): 18-22.

Skloot, Rebecca. *The Immortal Life of Henrietta Lacks*. New York: Crown Publishers, 2010. Print.

Snow White and the Seven Dwarfs. Prod. Walt Disney. Distributed by Buena Vista Film Distribution Co., 1937. Videocassette.

Uleman, James S., and John A. Bargh. *Unintended Thought*. New York: Guilford, 1989. Print.