THE EUROPEAN SOCIETY OF MEDICINE
Medical Research Archives, Volume 12 Issue 11

CASE REPORT

Insights from an Interdisciplinary, Co-taught Course on Birth, Death, and Medical History

Jennifer A. A. Gubbels[1] and Margaret H. Preston[2*]

[1]Augustana University, Department of Biology, Sioux Falls, SD USA.
[2]Augustana University, Department of History, Sioux Falls, SD USA.

*preston@augie.edu

OPEN ACCESS

PUBLISHED
30 November 2024

CITATION
Gubbels JAA and Preston MH, 2024. Insights from an Interdisciplinary, Co-taught Course on Birth, Death, and Medical History. Medical Research Archives, [online] 12(11). https://doi.org/10.18103/mra.v12i11.5995

DOI
https://doi.org/10.18103/mra.v12i11.5995

ISSN
2375-1924

ABSTRACT

This article discusses an interdisciplinary course titled: "Life's Cycles: Birth, Death, and the History of Medicine" and seeks to offer ideas to faculty that might enhance their own courses. "Life's Cycles" provides an enriching environment for science majors and non-science majors to learn the science, history and ethical dilemmas surrounding major medical and scientific discoveries. This is a four-week class to which students attend for 3.5 hours each day. Taught seven times since 2012 (with an average of 35 students), it is team-taught by two professors: one from history and the other biology. The course counts as an elective for the medical humanities and society minor and a scientific intersections course for the University's general education plan. This paper describes the innovative use of student group collaboration and discussion of relevant texts related to the history of medicine and medical ethics. The course includes invited guest speakers such as local physicians, nurse midwives, grief counselors, and other medical personnel. It also invites guests who have experienced significant illness. Students learn how the practice of medicine has evolved as a science; an understanding of disease progression and the ethical treatment of patients through lectures, discussions, films, podcasts, books, and articles. Rich discussion arises from the varied experiences of science majors, humanities, and social science majors. For the final project, students collaborate on researching a disease, producing a paper and making a film that all showcase the scientific understanding of the disease, its history, treatment and an associated ethical dilemma. Students have commented that the class has changed their perspective and provided deeper understanding on major life events.

Keywords: ethics, history of medicine, non-majors, medical humanities, team-teaching

Introduction

Over ten years ago, a professor of biology and a professor of history decided to co-teach a course that sought to provide students a deeper understanding of the history of medicine and some of the ills that plague the body. This course was part of a trend in US higher education that encourages students to recognize that a humane understanding of medicine benefits their future vocations. In describing this course, the authors seek to provide teachers with ideas for classroom collaboration as well as innovative projects to engage their understanding. This paper discusses a month-long course that challenges students from all disciplines to more deeply understand the cycles of life and how birth, disease and death will impact their personal and professional lives.

Through the 20th century while humanities programs were losing ground at the undergraduate level, the study of medical humanities increased at both the undergraduate and graduate level[1–3]. Adding ethical topics to science courses can increase student interest and help them make informed decisions;[4,5] as such, there are many benefits to infusing science courses with humanities topics. Additionally, there are benefits to courses that include a mix of science, social science, and humanities majors in ethical discussions. The interplay between these groups is becoming more essential in broader society which communicates science to those with little to no scientific background. Additionally, we must ensure that scientists are listening to what research and data is needed by those who benefit from it. Increasingly, "citizen science" is on the rise; in other words, lay people have a voice in pushing the trajectory of research and how data should be used[6]. We can begin these interactions in our undergraduate classrooms.

Below we discuss a unique undergraduate course titled, "Life's Cycles: Birth, Death, and a History of Medicine" where both science majors and non-science majors learn about medical advancements, the history of medicine and ethical issues within medicine and science– providing a robust environment for deep discussion and reflection. This paper seeks to share the results of a course taught multiple times since 2012 and suggest innovative ideas for any course, particularly one related to medical humanities.

"Life's Cycles" attracts pre-health students because it counts for credit in the University's Medical Humanities and Societies minor. In addition, it counts for "Scientific Intersections" credit in the general education plan. Students at this University are required to take a scientific intersections course to help them understand the role of science in their daily lives. The perspectives of students from a wide variety of disciplines and backgrounds results in rich discussion.

In evolving iterations of the course, it features understanding of the history of medicine, the increasing specialization of the science of medicine, the changes brought by technological innovation and practitioners' growing recognition and acceptance that patients are not the sum of their illnesses[1]. Through literature, film, historical readings and in-person presentations by medical practitioners, undergraduate students have come to recognize the role of and need for greater empathy in patient care.

The authors (professors of biology and history) have taught this course during the month of January (January-term) and it is the equivalent of a semester-long course with daily meetings of 3.5 hours. It has consistently included the themes of medical history, biology, reproduction, birth, and death woven throughout while adding sub-themes to correspond with current events over the years. The January-term allows for deeper discussions, guest speakers, and significant engagement in group work. Guest speakers have included the director of the in-vitro fertilization (IVF) lab, president of a local hospital, an obstetrician, nurse-midwife, endocrinologist, an integrative medicine physician, wellness coach, an In Vitro-fertilization patient, cancer and diabetes patients, a genetic counselor, a grief counselor, and more. This course has led to

deep conversation and writing from students, has been effective in changing student perceptions on discussed topics (according to course evaluation comments), and students tell us that the course itself is "life-changing." Below is a description of the course and discussion of the readings, videos, and speakers we have employed, in order to provide instructors of science and medical humanities courses with ideas to utilize in their own courses to add ethical discussions, or to create a similar course at their own institutions.

Course Description

Group Information and First day

Before the first day of class, the instructors put the students into groups based on the available demographic information. It is important that the groups include various majors, as the knowledge and experiences that each major has can benefit the group in different ways (being able to explain CRISPR to the group, or providing historical understanding to a topic). These groups of 3 or 4 (5 is too many) sit and collaborate together for the entire course. We utilize table tents from the first day and have the students write their names and assigned group numbers on the front and back of the tents. This is helpful for instructors to get to know student names, for students to know their classmates, and for guest speakers to see student names.

The first day also includes the presentation of a case study. The National Center for Case Study Teaching in Science[7] offers a vast collection of case studies. "An End to Ulcers", by Kristina Hannam and Rodney Hagley has been used each time[7]. This case study guides students through Barry Marshall and Robin Warren's Nobel Prize winning discovery that bacteria cause ulcers. We utilize this case study for several reasons: it contains several group discussion questions that help the groups begin to collaborate together, it has an exciting twist at the end when Marshall actually drinks a broth of *H. pylori* in order to infect himself (he cures himself), and it gives the students the first of several examples used in the course of the scientific community doubting hard evidence which goes against a long-standing dogma.

Assignments

Individual writing assignments

For every assigned reading, students turn in a brief writing assignment that includes an overview of the author's argument and questions that serve as the basis for class discussion. As the course progresses, the summary must include how prior speakers/films/readings, etc. influenced student thinking. Students do not have to answer the question; the purpose of the assignment is to encourage students to read, think deeply and connect the readings to other information that they are provided in the course. As the semester progresses, students are expected to cite prior readings and connect them with the current topic. It is helpful to provide an example of this assignment.

Individual Quizzes

Individual quizzes are given once per week and test student's attention during guest speakers, lectures, films, as well as reading assignments. Quizzes are multiple choice and short answer questions.

Group Project

This assignment includes an annotated bibliography, draft, final research paper and video. The topic is a disease that students will choose from a list provided by the professors on the first day of class. During the first week, a librarian speaks with the students about information technology and library facilities, including a green screen and available software.

A. The paper incorporates the following three elements:
    a. An understanding of the disease's history and if there are treatments.
    b. The specific (on a cellular level) cause of the disease.
    c. An ethical dilemma pertaining to the disease.

B. The above concepts should be explained in terms understandable to the general public. All three of these aspects should also be incorporated into the video.

Annotated bibliography
In order to encourage the students to begin their research, this assignment is due first. It requires 5 sources, one of which must be a primary source. Each 5-7-sentence annotation describes the source and whether it will be useful to the project.

Draft
Students submit a draft that is graded; this feedback provides students an opportunity to strengthen the work.

Final paper
Using feedback from the draft, students submit a final research paper with all components and required sources.

Video
Students produce a 12-14 minute video that incorporates the same three elements required in the paper. The video is expected to depict a fictional story about how the disease affects those who contract it. These videos are played on the last days of class with each group standing for questions after its presentation.

The video is graded on its content and creativity. Showing the video on the last days of class has been an excellent way to end the semester.

Class Discussion

In addition to general class discussion, at least once per week students participate in an exercise in which one student from each group sits in a center circle while the rest of the class sit in a circle around them. Students in the outer circle know they must pay attention to the central group's discussion as those on the outside will have their turn in the center. The first round is timed (5-8 minutes) and the center group discusses the topic/reading. At the end of time, each group meets and has 2-4 minutes to reflect on discussion and then sends a different representative into the central circle. This pattern repeats until all students have spent time in the center.

Course Reflection

On the last day of the class, the groups reflect on the course and answer questions, including: "who was your favorite guest speaker and why; what was the most significant historical and scientific fact you learned?" We have found that engaging the students in this reflective discussion emphasizes the course's concepts and brings an effective conclusion to the course.

Topics

The following is a select list of topics utilized. In response to changing interests, technologies, and current events, topics have been added or eliminated.

Reproduction
This topic has always been included. The biology professor presents on conception, pregnancy, and birth. The lecture begins with a series of questions about reproduction. Students are then asked to place anonymous questions on notecards that either the biologist, or that day's two guests, the obstetrician or nurse-midwife, will answer. Students also listen to a RadioLab podcast "Why So Many Sperm"[8], which tells the story about how sperm was discovered. Consideration of all that is brought into these 1-2 days will be included in a larger class discussion.

IVF is typically discussed either by the biologist or an IVF physician. In a few iterations, we invited a faculty member who had undergone IVF to class. She provided the students with an understanding of the physical demands that a woman's body undergoes in preparation for IVF. We also discuss pre-implantation genetic testing and its ethical considerations. This discussion of IVF engages with later conversations related to CRISPR, and this aids students to understand how CRISPR could be used to modify embryos.

Most recently students were shown an Anatomage virtual cadaver table which includes the virtual cadaver of a pregnant woman. Students see how the fetus is positioned within the body, the dislocation of organs in the abdomen because of the presence of the fetus, and the bones and muscles involved in the vaginal birth process. In addition, students were shown a scan of the fetal bones of an ectopic pregnancy.

Midwifery and the history of medicine

During each iteration of the course, the historian lectures on the history of medicine. Though no longer used, in early iterations, the students read Roy Porter's, Blood and Guts: A Short History of Medicine[11]. This text provides students with an understanding of the evolution of medicine, an understanding of disease and how medical care shifts from the home to hospital.

Because the course focuses on birth, the history of midwifery from the ancient world to the modern is discussed. As medical education became institutionalized, the tradition of midwifery and the women who practiced it were discredited and their communal position undermined. Childbirth became the realm of the physician. However, in recent decades, the practice of midwifery has returned to its position of importance and is a growing field of specialty.

A practicing nurse-midwife is invited to speak to the class; she gives her birthing perspective as compared to an obstetrician, who is also invited to speak. The difference in perspectives given by these two health care providers is not lost on the students, and, often, they reflect on those differences in their writing assignment. An episode of *Call the Midwife* is shown–specifically the episode during which a midwife performs a successful breech delivery[12].

Preterm Birth

For several years this course included Vicky Forman's This Lovely Life: A Memoir of Premature Motherhood[13]. In this memoir, the author, at 23 weeks, delivers twins and thus begins a story that challenges students to think about when a fetus is viable, who makes the decisions about viability, and the realities of caring for a premature infant (one twin dies) with serious health complications. To supplement this book and the discussion, we invite a neonatologist to class; this physician provides students with the latest information on preterm birth and discusses the many challenges parents face.

In later years, the biologist's research on disparities in preterm birth rates on Native American reservations in South Dakota has featured[14]. This led to a lecture about stress, epigenetics, and preterm birth rate disparities among U.S. racial and ethnic minorities. Additionally, the article "Black Mothers Keep Dying After Giving Birth"[15] provides additional context on health disparities and racism present in medicine.

Cholera

One book that we have included in almost every iteration of this course is Ghost Map by Stephen Johnson[16]. Johnson offers historical understanding of London during the industrial revolution and the suffering of Londoners during the outbreak of cholera in 1854. Ghost Map supplies students an understanding of the lack of sanitation that was the norm in ever growing urban centers like London. It also provides context for why, at the time, people thought that disease was carried by smell, or miasma, and how the scientific method (used by Dr. John Snow) helped to show that cholera was carried through water, not air. Nevertheless, Dr. Snow encountered significant resistance because most of the city's public health leaders refused to believe Snow's theory that the disease was carried through water by microscopic organisms. Historical examples of resistance to new theories that eventually prove true is a theme we visit regularly. Several other examples of researchers meeting resistance to their theories that prove true include: ulcers are caused by bacteria (as opposed to diet or stress) and that for some breast cancer patients, a lumpectomy can be just as effective as a radical mastectomy. The historian introduces discussion of the book with a lecture on industrialization and

European population growth in the nineteenth century and the biologist provides an explanation of how cholera affects the body.

Cancer

We have emphasized different kinds of cancer and the history of cancer treatment in the U.S. throughout iterations of this course. Often, students either read or watch parts of Suddartha Mukherjee's book/documentary, The Emperor of All Maladies[18,19], especially the chapters on breast cancer and the radical mastectomy versus lumpectomy controversy. This helps to emphasize the importance of patient advocacy, and how the egos of physicians can sometimes get in the way of the truth. A discussion of the biology of cancer, in particular ovarian cancer (as this is the biologist's specialty), is given, as an example of the etiology of one type of cancer.

Every year, an alumna, who was diagnosed with ovarian cancer a month after her graduation, gives a talk. Her presentation is by far one of the most popular with students. She was their age when she was diagnosed, and she shows them pictures of when she was a student. Her relatability, sadness and humor endear her to the students.

CRISPR

Recently the course used Walter Isaacson's The Codebreaker[20], which tells the story of Jennifer Doudna and her contribution to the discovery of CRISPR. This book reveals the humanness, competition, messiness, and excitement of scientific discovery. It gives an inside look into "lab life" and all of the players involved in discovery. The biologist provides a talk about how CRISPR functions. Students watch a Bozeman science video[21] and the Netflix documentary, "Human Nature"[22]. This documentary explains in lay terms what CRISPR is, how it was discovered, and how it can be used in medical research. Many of the same people featured in The Codebreaker are interviewed in "Human Nature". In addition, a genetic counselor discusses his work in helping families think about genetically inherited diseases.

Frankenstein

On the novel's 200th anniversary, we read Mary Shelley's Frankenstein[23]. While the use of Frankenstein is obvious to students in helping them to understand Shelley's warning of man's hubris, the students also read an article by Anne Jones that helps explain some of Shelley's nuances[24]. Jones suggests that if we look more deeply into Shelley's characters, we discover greater complexity. In particular, a character Jones notes that is often overlooked is Henry Clerval, a languages expert and friend of Frankenstein. Clerval's expertise in the humanities is contrasted to Frankenstein's scientific character. As Jones writes, Clerval "is consistently associated with affective qualities and skills that Frankenstein has not developed in his study of science"[24]. Thus, Shelley's warning is not solely to caution the sciences, but also to advocate for deeper knowledge of the humanities. Although we have only used the book once–more than once the course has used the 2015 film, *Victor Frankenstein*[25]. The reason to include this novel/film is to have students consider medical technology, and how then, as now, scientific experimentation can have unintended consequences. This conveys the notion that our society has long been concerned that a discovery at some point will make reproduction of humans easy and tailored to our whims. We can then compare the consequences imagined by Mary Shelley when Victor Frankenstein brings a man to life. Students compare this with the development of CRISPR technology and the story of He Jiankui who edited the DNA of embryos without regard for the consequences and despite the moratorium that the scientific community placed on embryo editing. These discussions encourage students to wrestle with the ethics of what science allows humans to achieve. These discussions are especially fruitful with a diverse group of majors.

Diabetes

Due to the rise in type 2 diabetes, this topic was added in recent years; diabetes has widespread implications for a population that is increasingly obese, making it relatable to students–most everyone knows someone who suffers from either

type 1 or type 2 diabetes. To introduce diabetes history and physiology, we begin with a brief introduction to the cause of type 1 vs. type 2 diabetes. Next, we show the documentary: "Matters of Life and Death"[26] about the discovery of insulin. This film exposes the humanity of people who work in laboratories, their challenges, brilliance, and flaws. To enhance student understanding, an endocrinologist speaks to the class. She talks about her work with diabetic patients and their daily struggles, which have benefitted from changing technology. She brings in many types of insulin pumps and injection needle samples for the students to view. In addition, we have had a faculty member who has type 1 diabetes talk to students about his life with diabetes. He provides details about his daily life and schedule as well as the cost of insulin.

Palliative Care and Death

Like birth, a discussion of end of life has always been included. As preparation for the week, students watch the Frontline documentary (based on Atul Gawande's book), Being Mortal[27] , in which Gawande follows several physicians and their patients who are facing a cancer diagnosis; among these is Gawande's father who develops terminal cancer. This documentary shows students how death can be humanely approached. This documentary is paired with a RadioLab podcast on Elizabeth Kubler-Ross's "Five Stages of Grief"[28] which gives students a deeper understanding of Kubler-Ross' work[29].

To begin the week, a palliative care physician talks about options for persons at the end of life. She discusses hospice care and when an individual should choose this next step. She speaks on the ethical decisions made by next of kin and the recent challenges related to legally recognizing the rights of the surviving partners of same-sex couples. In addition she discusses who decides and when to put in place a "do not resuscitate" order, and how this can affect family dynamics. She brings up these topics through examples of patient experiences.

Next, the grief counselor, who has a Ph.D. in psychology and is a music therapist, provides the students with a grief counseling session and an understanding of death and grief. Although this individual speaks of grief and loss, he always provides an element of hope, and teaches the students how to take the memories of their loved one and move it from their minds into their hearts. He gives them different kinds of tactics for dealing with grief, including, for example, writing a letter to the lost loved one. Into his discussion with the students, he incorporates several different songs that were written in grief, including John Lennon's "Mother" and Eric Clapton's "Circus." The hope is that students gain insight into their own grief and how grief will affect their future patients, students, or colleagues.

Student Feedback

Anonymous comments from course evaluations from the last three years the course was taught were collated and sorted into themes. These course evaluations are given in the last few days of the semester. Some of the questions that are asked include: "What is the most significant scientific fact you have learned in this course? What is the most significant historical fact that you have learned in this course? What knowledge will you take with you that will stay with you the rest of your life?" We have the students write these individually. The themes are presented below with representative student comments in quotes. A proposal for the use of these comments was submitted to the University's IRB who deemed the project exempt.

The following themes from the student comments were gathered:

1. Death and Grief. For many students, death and grief are not spoken about in life or in courses they have taken. They appreciated the lessons they learned about dealing with grief from the counselor's visit. Several students mentioned that this talk contained information that they will take with them throughout their life.

". . . {discussion on grief} was very insightful. I learned a lot about grief and how to deal with it in my own life. I think this subject should be talked about more and isn't something we get in other classes."

[The grief counselor's] presentation was honestly somewhat life-changing. I learned to retain a broad perspective and realized some people have much more difficult stories than myself. Also, I feel more comfortable facing grief head on the first time I experience a great loss. "

2. The Science of Reproduction. The science and physiology of how egg and sperm meet, pregnancy, and childbirth were new topics for many students, causing honest concern for the authors about the preparation of sex education courses of high schools in the area. The opportunity to listen to the stories and philosophies about pregnancy and childbirth from both OBGYNs and nurse midwives was eye-opening.

"Midwife vs. OBGYN: Really cool to see the two sides of childbirth, didn't realize there was a huge difference between the two. Better understanding of the psychological and emotional effects of childbirth."

"My school didn't really talk about sex education, so I had no clue that a woman could get pregnant if she had unprotected sex near ovulation."

"I found all of the people who spoke about pregnancy and reproductive science interesting. I did not know hardly a thing about that kind of study."

3. Understanding CRISPR and future implications. Many students appreciated achieving a basic understanding of what CRISPR is, and were generally unsettled about what could be done (especially in the world of IVF) with the technology.

"Jennifer Doudna's [Code Breaker] story about realizing girls could do science will stick with me. A lot of her light bulb moments as a young scientist entering the world of science and research have been experiences I can relate to on some level."

"I think having a good understanding of CRISPR moving forward will be really important."

"Codebreaker had essential information about gene technologies, and they are going to be present in our lives from now on, especially in the medical field."

4. The physical and emotional experience of cancer treatment. The cancer survivor who tells her story of being diagnosed with ovarian cancer a few days after graduating from college is always a moving experience for the students. Students commented both on how difficult the treatment was for her, as well as having a new understanding of how cancer can affect someone for the rest of their lives, even though they are "cured." Many commented also on her resilience throughout the experience.

"[cancer survivor] her story was amazing and I thought that it taught me that doctors don't always believe their patients. Her story was so raw and real, and it was a good reminder that just because you survive/get cured from something doesn't mean you are free from it, there can be lasting effects."

"[cancer survivor] had to advocate for herself because no one believed her. So, standing up when something doesn't feel right and keep trying to get help or a diagnosis if no one is listening."

5. Long-standing scientific dogmas are difficult to overcome. Students commented often that "history repeats itself," in that it has been difficult throughout history to overturn ideas that had long held to be true. The fact that cholera is water-borne

and not airborne, that the lumpectomy has the same survival as the radical mastectomy, and that there are certain types of bacteria that cause ulcers are all examples of long-held dogmas that were eventually overturned by data obtained by utilizing the scientific method.

"I think I will continually think about people's doubt of science throughout history. People continually don't believe in new findings. It takes a lot of work and time to try to prove a theory/finding."

It was not unusual to have students state that they have learned information that will help them throughout their lives:

". . . most of the topics from this class have had an impact on me and I will carry with me throughout my life."

Conclusion

"The flourishing of medical humanities is a story of shifting energies…as the field has grown, its questions about illness, disease and the pursuit of health have become more prominent across the academy and beyond its boundaries"[3]. Reflecting the changes of which Wailoo wrote, in 2020, the University at which this course is taught launched its Medical Humanities and Society Minor. This evolved from the interdisciplinary effort to increase student understanding of how the arts, humanities and social sciences can play an important role in patient care. The "Life's Cycles" course has become one among many courses central to the minor. In addition, because this course also counts as a general education credit under the category of "Scientific Intersections," the course is populated by a diverse group of students from across campus, enriching the experience for all. The discussions that take into consideration the implications of scientific research for society (such as CRISPR modification of embryos), benefit from a wide array of backgrounds and experiences. Students learn about other ideas that have just as much merit and justification as their own.

Humanities and social science majors bring a wealth of perspective that differs from what science majors may encounter in their own classes. Science majors then provide the analytical thinking and technical training of their discipline. Therefore, the discussions can bring a blend of reflection, experience, and data analysis that can provide new insights to both groups. We hope that these discussions will allow students to hone sharper listening skills to those who are in vulnerable positions in their professional and personal lives. This is why the course emphasizes the voices of both patients and scientists who, with data in hand, speak out against tradition in medical practice to advocate for new ways of thinking and treating patients[30]. In particular, when we discuss examples in class where physicians or scientists resist hard evidence (for example, the hard road by which Drs. Warren and Marshall proved that some ulcers are caused by bacterial infection), we want students to both question tradition and be willing to accept new evidence.

Not only were the students from diverse fields, but the instructors were as well. The ability to combine the scientific with the historical content, ways to assess students from quizzes to videos and discussions, as well as the connections throughout the local health care system for guest speakers would not have been nearly as robust if we had taught this course alone. The course has consistently enrolled enough students to legitimize two interdisciplinary (biology and history) faculty members to team teach. This course has been a valuable experience for both faculty and students, and we encourage administrators to find ways to enable this kind of teaching.

As current topics, student learning styles, and technology have changed, we have molded the course to adapt to these changes while keeping the fundamental themes consistent. Because it has been an intensive one-month course, the longer daily course time has allowed for excellent discussions, the viewing and discussion of films, and extended times for guest speakers and questions. However, this is not a requirement for

the course. The chance to discuss and collaborate with students across campus on serious topics has opened their eyes to diverse perspectives. The ethical dilemmas discussed have given students new ideas to consider and the lessons will carry with them in their personal and professional lives.

Acknowledgements:

The authors would like to thank the students who made this course engaging, exciting, and educational for us. We would also like to acknowledge the many speakers who freely gave of their time to speak to our students about sometimes very personal issues. Finally, we would like to acknowledge Drs. Maureen Diggins and Ann Peterson, who originated and inspired this course.

Conflict of Interest:

The authors have no conflicts of interest to declare.

Funding Statement:

None.

References:

1. Carson RA. Engaged humanities: moral work in the precincts of medicine. *Perspect Biol Med*. 2007;50(3):321-333. doi:10.1353/pbm.2007.0025

2. Klugman CM. How Health Humanities Will Save the Life of the Humanities. *J Med Humanit*. 2017;38(4):419-430. doi:10.1007/s10912-017-9453-5

3. Wailoo K. Patients Are Humans Too: The Emergence of Medical Humanities. *Daedalus*. 2022;151(3):194-205. doi:10.1162/daed_a_01938

4. Johansen CK, Harris DE. Teaching the Ethics of Biology. *Am Biol Teach*. 2000;62(5):352-358. doi:10.2307/4450918

5. Stutz J. Integrating Applied Ethics Into a College-Level Non-Majors Biology Course. *Teach Ethics*. 2011;11(2):47-56. doi:10.5840/tej20111126

6. Bedessem B, Ruphy S. Citizen Science and Scientific Objectivity: Mapping Out Epistemic Risks and Benefits. *Perspect Sci*. 2020;28(5):630-654. doi:10.1162/posc_a_00353

7. NCCSTS Case Studies | NSTA. Accessed March 11, 2024. https://www.nsta.org/case-studies

8. Why So Many Sperm? Radiolab Podcasts | WNYC Studios. Accessed February 29, 2024. https://www.radiolab.org/podcast/91647-why-so-many-sperm

9. Sweet V. *God's Hotel: A Doctor, a Hospital, and a Pilgrimage to the Heart of Medicine*. Reprint edition. Riverhead Books; 2013.

10. *PBS Frontline: Sick Around the World.*; 2017. Accessed February 29, 2024. https://www.youtube.com/watch?v=h4rg-DJBd34

11. Porter R. *Blood and Guts: A Short History of Medicine*. Reprint edition. W. W. Norton & Company; 2004.

12. Call the Midwife. *Browne Episode*. Published online January 22, 2012.

13. Forman V. *This Lovely Life*. Original edition. Mariner Books; 2009.

14. Abbott KM, Boyens BMS, Gubbels JAA. Intergenerational Talking Circles Exploring Psychosocial Stressors for Preterm Birth and Strategies for Resilience among American Indian Women. *J Transcult Nurs*. 2022;33(3):268-277. doi:10.1177/10436596221081269

15. ProPublica NM. Black Mothers Keep Dying After Giving Birth. Shalon Irving's Story Explains Why. *NPR*. https://www.npr.org/2017/12/07/568948782/black-mothers-keep-dying-after-giving-birth-shalon-irvings-story-explains-why. December 7, 2017. Accessed July 1, 2024.

16. Johnson S. *The Ghost Map 1st (First) Edition Text Only*.

17. Skloot R. *The Immortal Life of Henrietta Lacks*. Reprint edition. Crown; 2011.

18. Cancer: The Emperor of All Maladies | Ken Burns | PBS. Cancer: The Emperor of All Maladies | Ken Burns | PBS. Accessed July 3, 2024. https://www.pbs.org/kenburns/cancer-emperor-of-all-maladies/

19. Mukherjee S. *The Emperor of All Maladies: A Biography of Cancer*. Reprint edition. Scribner; 2011.

20. Isaacson W. *The Code Breaker: Jennifer Doudna, Gene Editing, and the Future of the Human Race*. Simon & Schuster; 2022.

21. *What Is CRISPR?*; 2016. Accessed July 3, 2024. https://www.youtube.com/watch?v=MnYppmstxIs

22. *Human Nature*. Sandbox Films (II), News and Guts Films, The Wonder Collaborative; 2020.

23. Shelley M, Gordon C, Robinson CE. *Frankenstein: The 1818 Text*. Penguin Classics; 2018.

24. Jones AH. Frankenstein as Cautionary Tale for Medical Humanities? A Brief Coda. *Perspect Biol Med*. 2019;62(4):710-716. doi:10.1353/pbm.2019.0041

25. *Victor Frankenstein*. Davis Entertainment, TSG Entertainment, Moving Picture Company (MPC); 2015.

26. Matters of Life and Death. *Sci Odyssey*. Published online January 11, 1998.

27. *Being Mortal (Full Documentary) | FRONTLINE.*; 2020. Accessed February 29, 2024. https://www.youtube.com/watch?v=lQhI3Jb7vMg

28. Kübler-Ross E. *On Death And Dying - What The Dying Have To Teach Doctors, Nursess, Clergy And Their Own Families*. Later prt. edition. Scribner; 2003.

29. The Queen of Dying. Radiolab Podcasts | WNYC Studios. Accessed July 3, 2024. https://www.radiolab.org/podcast/queen-dying

30. Kuczewski MG. The Soul of Medicine. *Perspect Biol Med*. 2007;50(3):410-420.

