BSC2460: Can we design "better" humans? Should we?

Quest 2

I. General Information

Class Meetings

- Spring 2026
- Meetings: Online Asynchronous

Instructor

- Brian Harfe
- Office hours are Monday 8:00-9:00 am (Zoom) and Wednesday 3-4 pm (Zoom). Please send Dr. Harfe an email, and he will send you a Zoom link. In person by appointment.
- Contact: bharfe@ufl.edu

Teaching Assistant

- TBD

Course Description

The creation of a human that has specific traits or superhuman abilities has been a central theme in science fiction for decades. An outstanding example of a "created" superhuman comes from the iconic story of how a scrawny kid from the Lower East Side of Manhattan in 1940 was transformed into Captain America. While a body-altering "super serum" seems unlikely, especially in a time period when penicillin was just starting to be widely used, is the creation of a superhuman possible using our current understanding of the human body?

For >70 years, it has been known that the DNA present in each one of our cells is the blueprint that makes us human. In 2003, the blueprint (I.e., the "human genome") was made freely available to the entire world. Contained within this blueprint are the directions responsible for making every part of the human body and controlling how it works. Upon the publication of the human genome, it became possible, in theory, to modify specific parts of our blueprint to generate a human with specific characteristics (i.e., a "designer human"). But should we?

In this course, we will explore two broad questions: 1. Can a human be created that has specific characteristics, and 2. Should we design "better" humans? We will examine the technologies behind how the human genome can be modified and discuss the controversies surrounding

these technologies. Both of these questions will be addressed through an international lens since many of the scientific breakthroughs that allow us to even ask the above questions, and the resulting ethical discussion surrounding these discoveries, were developed outside the US.

At the end of the course, students will have an understanding of what is currently possible and impossible in the field of human cloning. Students will be able to lead discussions with their peers on the ethical questions surrounding this rapidly advancing field, interpret new breakthroughs, and understand how manipulation of the human genome may affect their and the public's future health.

Optional Study Abroad Trip: IDS 4956: UF in the UK: Exploring Science (in Scotland and London)

Students can register for a separate one-credit study abroad trip that will take place in the Spring 2026 semester. On this trip, students will travel to London (England), Glasgow (Scotland), and Edinburgh (Scotland) to further explore some of the topics included in this Quest 2 course (see below for a trip itinerary).

Quest and General Education Credit

- Quest 2
- International (N)

This course accomplishes the Quest objectives of the subject areas listed above. A minimum grade of C is required for Quest credit. Courses intended to satisfy Quest requirements cannot be taken S-U.

Required Readings and Works

Required readings/works:
Chasing Captain America: How Advances in Science, Engineering, and Biotechnology Will Produce a Superhuman by Paul Zehr, (2018) 224 pages

The Double Helix: A Personal Account of the Discovery of the Structure of DNA by James D. Watson, (NOTE: 2001 version, not the 1968 version) 256 pages

The Code Breaker: Jennifer Doudna, Gene Editing, and the Future of the Human Race by Walter Isaacson (2021) **Select** chapters from the 560-page book (see the "Annotated Weekly Schedule" for details). The paperback version (which came out in 2023) is recommended since it is much cheaper!

Movie: GATTACA (1997; 1hr 46 minutes). Can be viewed through Amazon Prime ($2.99), YouTube ($3.99), Goggle Play Movies ($3.99), Apple TV ($3.99), or Vudu ($2.99)

All other readings and works are available in Canvas or through course reserves.
Instructional materials for this course consist of only those materials specifically reviewed, selected, and assigned by the instructor. The instructor is only responsible for these instructional materials

Optional additional readings/videos:

Rosalind Franklin: The Dark Lady of DNA by Brenda Maddox (2003) 416 pages by Brenda Maddox

- Biography of the scientist who provided the key piece of information Watson and Crick needed to decipher the structure of DNA "but who was airbrushed out of the greatest scientific discovery of the twentieth century" (Brenda Maddox).

Foundation (2021 TV series on Apple TV+).

- While the series is only loosely based on the novels by Isaac Asimov, there is an interesting storyline that revolves around human cloning (as an aside, this storyline is not part of the Asimov books).

Materials and Supplies Fees: n/a

II. Graded Work

Description of Graded Work

Grades will be weighted as follows:

% OF FINAL GRADE	DESCRIPTION	DUE DATES
6%	**Initial thoughts on human cloning.** See rubric below for grading. 2-3 double-spaced pages. No references, reading, or research should be performed to complete this assignment. This assignment should reflect your initial thoughts regarding cloning and genetic modifications of humans.	Due by Sunday 11:59 PM of week 1.
20%	**Weekly quizzes.** Quiz on the readings, films, and lectures presented each week. There are 10 total quizzes each worth 2% of your final grade. Each Quiz will contain ~10 multiple choice questions. Quizzes will be taken online in Canvas.	Due by Sunday at 11:59 PM each week (no quizzes in Modules 1, 9, 10, 11 and 15).
10%	**Discussion topic.** Post your thoughts on the week's discussion topic. Comment on two of your classmates' posts. Discussions posts will be submitted in Canvas. There are 10 total discussion topics, each worth 1% of the final grade.	Initial post due Friday by 11:59 pm. Comments on classmate posts due by Sunday at 11:59 PM each week
5%	**Course surveys:** Complete two anonymous surveys on human cloning, two anonymous surveys on your views of global awareness and intercultural communication, and an anonymous mid-course survey regarding improvements you would like to see in the course.	Surveys will be administered the first meeting period (Module 1; human cloning and global awareness surveys), as an assignment in Module 8 ("mid-course improvement survey"), and during the last week of the course (Module 15; human

		cloning and global awareness surveys)
15%	**Human cloning team project.** You will work as a team to answer one of the three prompts discussing human cloning. The project will be presented either in person during class, as a video presentation, or as a podcast.	Due Module 13
24%	**Assignments. See Canvas for assignments.**	Weekly
20%	**Final Paper: Reflections on human cloning.** See rubric below for grading. 4-6 double-spaced pages (not including any references). See Assignment Details below for more information.	Last Day of Class

Please note that all Assignments for the week should be completed BEFORE attempting the weekly Quiz. The weekly Quiz can only be taken once and contains questions from the material presented in the week's lectures and from the week's assigned material.

Grading Scale

For information on how UF assigns grade points, visit: https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/

A	94 – 100%		C	74 – 76%
A-	90 – 93%		C-	70 – 73%
B+	87 – 89%		D+	67 – 69%
B	84 – 86%		D	64 – 66%
B-	80 – 83%		D-	60 – 63%
C+	77 – 79%		E	<60

Grade Rounding

Final grades will be rounded up to the nearest whole number. For example, if your final grade is a 93.5, I would round up to an "A", but if your final grade is a 93.4, it will be an "A-". No exceptions will be made.

Assignment Details and Grading Rubrics

Discussion prompts

Discussions are thought-provoking conversations with your classmates. Each discussion requires you to post a reply to the week's topic and comment on two of your classmates' posts. All posts and responses are entered in Canvas. Please enter separate replies to each of your classmate's posts. Your initial post is due by 11:59 pm on Friday. Comments on two of your classmates' posts are due by Sunday at 11:59 PM each week (there will be no discussion topics in Modules 8, 9, 10, 14, and 15). This assignment will count for 10% of your final grade and will be graded on a 1-3 scale. One point will be provided for each post (i.e., each week, 1 point will be awarded for the initial post, and 1 point for each of the two responses to a classmate's post = 3 points total/week).

Surveys on human cloning and global awareness

An anonymous survey on your views on human cloning and your personal views of global awareness and intercultural communication will be given in Modules 1 and 14. The surveys will be identical each time they are administered. Points will be awarded each time a survey is completed, for a total of 6% of your final grade. Points will be awarded upon successful completion of each survey. Questions will include your thoughts on human cloning, genetic engineering, and your views on global awareness and intercultural communication.

*the survey used to quantify "personal views of global awareness and intercultural communication" will be *The International Critical Thinking (IntCRIT) and International Communication (IntCOMM) scales* survey (University of Florida (2014); used by permission).

Extracting DNA from strawberries (assigned in Module 2)

Strawberries contain eight (!) copies of each of their chromosomes. This makes them excellent starting material to extract DNA from. In this experiment, using household (or dorm) items you will extract DNA from strawberries following the procedure found here:
https://www.genome.gov/Pages/Education/Modules/StrawberryExtractionInstructions.pdf

*this project can be performed individually or as a team of TWO. Teammates will receive the same grade. If done as a team, each teammate should upload, individually, the same pictures (see below grading rubric).

Grading Criteria	**Points**
Upload picture of you (or your teammate) mashing strawberries	1
Upload a picture of your "extraction liquid"	1
Upload a picture of you with your extracted strawberry DNA (if the project was performed as a team, note both teammates' names either on the uploaded picture or as a comment in Canvas).	2
Total Points	4

Human cloning team Project (due Module 13)

***All members of a Team should come from students present in the same breakout class session**

You will work as a team to answer one of the three prompts discussing human cloning. These prompts can be found in the "Details of Experiential Learning Component" below. The project will be presented by the team during (Module 13). Presentations can be submitted as a video, as a podcast, or in person during class meeting times. Additional instructions on the formats will be discussed in week 1 of the course. This assignment will count for 15% of your final grade and will be graded on a 0-15 scale following the below rubric. 10/15 points will be awarded based on your own work (designated as "I" below). 5/15 points will be awarded to the "team" portion of the project (designated as "T" below). All teammates will receive the same "T" part of the grade. Each teammate will submit the same 1-page policy paper, which should include any "minority opinions" (see below).
*__**Please write all of your teammates' names at the top of the policy paper that you submit.**__

Minority Opinions: A consensus viewpoint does not need to be reached to successfully accomplish the project. In the policy paper, minority opinions should be presented if all teammates do not agree with the majority opinion. Multiple minority opinions can be included if needed.

"T" = Team portion of the project (the same grade will be assigned to all team members). "I" = Individual portion of the project (to be performed individually and will be graded separately from the team portion

of the project). The I + T parts of the project will equal 15 points (i.e., 15% of your total grade in the course).

Grading Criteria	**Points**
Produce a policy paper (1 page). Clearly state the team position on the question chosen and the specific regulations and conditions that would be put in place. How different cultural views and/or how international regulations may affect the implementation of the proposed policies should be addressed. Please note that a consensus viewpoint does not need to be reached by the team to successfully accomplish the project (see above). All team members should include this one page in their report.	3 (T)
Justify why YOU support the chosen position on the topic (2-3 double-spaced typed pages). If you disagree with the team's position, state why.	4 (I)
Provide three examples to support YOUR position (within the 2-3 pages where you justify why YOU support the chosen position)	6 (I)
Presentation is clear and represents the opinions, including any minority opinions, of the team.	2 (T)
Total Points	15

Summary of what will be submitted in Canvas:

- 1 page policy paper (same for all Team members)
- 2-3 double-spaced typed pages where you justify your opinion and provide three examples to support your position (unique for each student).

Reflections on human cloning. This activity contains two parts:

Please note that there is no "correct" answer for this assignment. In addition, your views do not have to be 100% for/against human cloning. In part two of the assignment, your views may not change at all, slightly change, or significantly change.

1. **Initial thoughts on human cloning** (due 11:59 pm Sunday at the end of the first week of the class). This assignment should reflect your current thoughts regarding cloning of humans and modification of human DNA**.** The paper should be 2-3 double-spaced pages. No references, reading, or research should be performed to complete this assignment. It will count for 6% of your final grade and will be graded on a 0-6 scale following the below rubric. Additional details on this assignment can be found in the "Self-Reflection Component" section below.

Grading Criteria	**Points**
Paper ideas are clearly presented	3
Reasons are provided to support your thoughts on the topic	3
Total Points	6

2. **Final Paper: Reflections on human cloning** (due 11:59 pm on the last day of the course; late submissions will not be accepted). During the semester, you have learned a lot about cloning/genetic modifications of humans. In your final paper, you will discuss what data you need to be presented with to change your views of cloning and/or the genetic modifications of humans. **The first draft of the paper was written using a chatbot!** As you learned in this course, chatbots can create essays on many different topics. For the final assignment, you will use the chatbot-generated first draft of your essay.

Final Paper Rubric

Final Paper Rubric

Criteria	Ratings		Pts
Part A. Both surveys are filled out (2 points for each survey that is filled out)	**4 to >0.0 pts Present**	**0 pts Absent**	4 pts
Part B. The essay reflects your view of human cloning and the genetic modification of humans.	**2 to >0.0 pts Present**	**0 pts Absent**	2 pts
Part B. The essay discusses four ways that human cloning could be used to improve human health and/or be detrimental to human health, and discusses two ways that human genetic engineering could be used to improve human health and/or be detrimental to human health (1 point for each).	**4 to >0.0 pts Present**	**0 pts Absent**	4 pts
Part B. Essay reflects your views on what you believe will occur in the next ten years in the field of human cloning and the genetic modification of humans.	**2 to >0.0 pts Present**	**0 pts Absent**	2 pts
Part C. Explanation of why/why not the text reflected **your views** on human cloning and the genetic modification of humans. If changes were made, describe why you made these changes. If no/few changes were made, describe why.	**4 to >0.0 pts Present**	**0 pts Absent**	4 pts
Part C. Explanation of why/why not the text reflected **your style** of writing. If changes were made, describe why you made these changes. If no/few changes were made, describe why.	**4 to >0.0 pts Present**	**0 pts Absent**	4 pts
Total Points: 20			

III. Annotated Weekly Schedule

Module	Topics, Homework, and Assignments
Module 1	• **Topic:** Course Introduction and discussion of the topic "What is human cloning?"

Module	Topics, Homework, and Assignments
	• **Summary:** Course introduction and presentation on how the quizzes and assignments will be graded. Orientation for the team project. Is it possible to create a super soldier? Complete human cloning and global awareness surveys. • **Required Readings/Works**: - The Double Helix: A Personal Account of the Discovery of the Structure of DNA by James D. Watson (pages 1-82). - "The story of Dolly the cloned sheep" (RETRO report, The New York Times) 14 minutes https://www.youtube.com/watch?v=tELZEPcgKkE - Chasing Captain America: How Advances in Science, Engineering, and Biotechnology Will Produce a Superhuman by Paul Zehr (pages 1-26) - View the original Watson and Crick model of DNA on display at the Science Museum, London, UK https://collection.sciencemuseumgroup.org.uk/objects/co146411/crick-and-watsons-dna-molecular-model-molecular-model • **Assigned work DUE by Sunday at 11:59 pm:** - Complete "pre-course" reflection on your views of human cloning/genetic modification (see Reflections on Human Cloning, Part One, above). Complete Discussion prompt 1.
Module 2	• **Topic:** What is DNA? • **Summary:** Introduction to DNA and what it is used for in the human body. Lectures on how DNA was discovered and how the sequence of DNA was determined. Required readings demonstrate how the international race to discover the structure of DNA unfolded. • **Required Readings/Works**: - The Double Helix: A Personal Account of the Discovery of the Structure of DNA by James D. Watson (pages 83-148). - Watch "The Double Helix" by HHMI (2013) 16 minutes https://www.biointeractive.org/classroom-resources/double-helix - Chasing Captain America: How Advances in Science, Engineering, and Biotechnology Will Produce a Superhuman by Paul Zehr (pages 27-59) • **Assigned work DUE by Sunday at 11:59 pm:** Quiz 1 and Discussion prompt 2. • **Class Assignment DUE by Sunday at 11:59 pm:** DNA extraction from strawberries. See link for the procedure to be followed. See section V. "Quest Learning Experiences" for explanation on how to complete the assignment. https://www.genome.gov/Pages/Education/Modules/StrawberryExtractionInstructions.pdf
Module 3	• **Topic:** Molecular Biology: Techniques used to alter DNA • **Summary:** Lectures on the discovery and use of restriction enzymes. The mid-1970's ethical debate on DNA manipulation and how the Asilomar conference of 1975 set international policy on how DNA could be modified, will be discussed. • **Required Readings/Works**: - The Double Helix: A Personal Account of the Discovery of the Structure of DNA by James D. Watson (pages 149-226). - The Code Breaker: Jennifer Doudna, Gene Editing, and the Future of the Human Race by Walter Isaacson

Module	Topics, Homework, and Assignments
	- Part 1 "Origins of Life" pages 1-67. Note: pages 17-28 "DNA" is a brief, balanced retelling of the Watson "*The Double Helix*" book that you finished reading this week. - "Watson Revisited" and "Doudna Pays a Visit" pages 385-398 - Read "Asilomar 1975: DNA modification secured" (2 pages) by Paul Berg https://www.nature.com/articles/455290a.pdf • **Assigned work DUE by Sunday at 11:59 pm:** Quiz 2 and Discussion prompt 3 • **Class Assignment DUE by Sunday at 11:59 pm:** Before completing the assignment, view and interact with the web site "How do Restriction Enzymes Cut Plasmids" https://www.labxchange.org/library/items/lb:LabXchange:783397ff:lx_simulation:1 - Complete the assignment "Using restriction enzymes to determine DNA size" • **Optional/Supplemental reading:** - "The Unusual Origin of the Polymerase Chain Reaction" by Kary Mullis, Scientific American April 1990. Pages 56-65 - "1978 Nobel Prize Press release (~2 pages) https://www.nobelprize.org/prizes/medicine/1978/press-release/ - "Restriction Enzymes" (~2 pages) by Heidi Chial https://www.nature.com/scitable/spotlight/restriction-enzymes-18458113/
Module 4	• **Topic:** What are "model organisms" and how are they used? • **Summary:** What a model organism is will be defined and then discussed in the context of how discoveries using model organisms lead to breakthroughs. The advantages and disadvantages of using model organisms will be presented. • **Required Readings/Works**: - Chasing Captain America: How Advances in Science, Engineering, and Biotechnology Will Produce a Superhuman by Paul Zehr (pages 60-102) • **Assigned work DUE by Sunday at 11:59 pm:** Quiz 3 and Discussion prompt 4. • **Optional/Supplemental reading:** - "What's so special about model organisms?" by Rachel Ankeny and Sabina Leonelli (2010) 11 pages. - "Frogs used to tell women they were pregnant with nearly 100% reliability" by Dave Mosher. ~2 pages https://www.businessinsider.com/xenopus-frogs-pregnancy-test-2017-8
Module 5	• **Topic:** Mighty mice: Myostatin and why you don't want much. • **Summary:** Students will learn how mice with two-times the amount of muscle were created. Can humans be genetically modified to increase their amount of muscle? What would be the benefits/drawbacks of modifying humans to have extra muscle? • **Required Readings/Works**: - Mighty Mice in Space! https://www.jax.org/miceinspace Watch the video "Helping those in need" (5 minutes and 20 seconds). Read all text on this web page (~2 pages). - Chasing Captain America: How Advances in Science, Engineering, and Biotechnology Will Produce a Superhuman by Paul Zehr (pages 103-144) • **Assigned work DUE by Sunday at 11:59 pm:** Quiz 4 and Complete Discussion prompt 5.

Module	Topics, Homework, and Assignments
	• **Class Assignment DUE by Sunday at 11:59 pm:** From the Mighty Mouse in Space; see link (https://www.jax.org/miceinspace) and complete Lesson 1: Making Predictions – Student Version and upload via Canvas. You ONLY need to complete Lesson 1. • **Optional/Supplemental reading:** - "The man of steel, myostatin, and super strength" https://blogs.scientificamerican.com/guest-blog/the-man-of-steel-myostatin-and-super-strength/ (2 pages) - "Molecular medicine keeps mice mighty in microgravity" (2 pages) https://www.scientificamerican.com/article/molecular-medicine-keeps-mice-mighty-in-microgravity/
Module 6	• **Topic:** Types of genetic changes: germline vs somatic (and what does this mean?) • **Summary:** Introduction to how human DNA can be altered. Explanation of CRISPR-Cas9 and the international race for the Nobel Prize. The difference between a "germline" and "somatic" DNA change will be explained. • **Required Readings/Works**: - The Code Breaker: Jennifer Doudna, Gene Editing, and the Future of the Human Race by Walter Isaacson - "CRISPR-Cas-9", "Science", "Dueling Presentations" pages 130-149. Note the quote "The collaboration was like a model United Nations" and the description of the international nature of scientific research. - Watch Dr. Jennifer Doudna TED talk on "How CRISPR lets us edit our DNA" https://www.youtube.com/watch?v=TdBAHexVYzc (16 minutes) - Chasing Captain America: How Advances in Science, Engineering, and Biotechnology Will Produce a Superhuman by Paul Zehr (pages 145-167) - "Her Discoveries changed the world. How does she think we should us it" by David Marchese, *NY Times* Aug 12, 202 (~3 pages) https://www.nytimes.com/interactive/2022/08/15/magazine/jennifer-doudna-crispr-interview.html • **Assigned work DUE by Sunday at 11:59 pm:** Quiz 5 and Discussion prompt 6. • **Optional/Supplemental reading:** - "CRISPR, 10 Years On: Learning to Rewrite the Code of Life" by Carl Zimmer. NY Times https://www.nytimes.com/2022/06/27/science/crispr-gene-editing-10-years.html - "CRISPIR-Cas9: The Gene Editing Tool that is Changing the World" by Clara Rodriguez Fernandez (11 minutes to read) - "What is CRISPR and why is it conversional? By Katie Hunt (CNN; ~2 pages) https://www.cnn.com/2020/10/07/health/what-is-crispr-explainer-scn-trnd/index.html - View "CRISPR-Cas9 Applications" (HHMI; click "Launch interactive") https://www.biointeractive.org/classroom-resources/crispr-cas-9-mechanism-applications - "The major genetic risk factor for severe COVID-19 is associated with protection against HIV" https://www.pnas.org/doi/10.1073/pnas.2116435119
Module 7	• **Topic:** Human "Cloning" and "Germline Editing": What it is and what it is not.

Module	Topics, Homework, and Assignments
	• **Summary:** The difference between cloning and germline editing of DNA will be discussed. How can the human genome be changed and is it ethical to do so? • **Required Readings/Works**: - Chasing Captain America: How Advances in Science, Engineering, and Biotechnology Will Produce a Superhuman by Paul Zehr (pages 168-186) - "Human reproductive cloning: The curious incident of the dog in the night-time" by Henry T. Greely (2020) ~3 pages (https://www.statnews.com/2020/02/21/human-reproductive-cloning-curious-incident-of-the-dog-in-the-night-time/) - Virtually visit Dolly at the National Museum of Scotland (https://www.nms.ac.uk/explore-our-collections/stories/natural-sciences/dolly-the-sheep/ - https://www.nature.com/articles/d41586-018-03268-4 - https://www.closerlookatstemcells.org/2021/08/05/setting-the-standards-new-stem-cell-research-guidelines-released/ • **Assigned work DUE by Sunday at 11:59 pm:** Quiz 6 and Discussion prompt 7. • **Optional/Supplemental reading:** - "The global governance of human cloning: the case of UNESCO" by Adele Langlois (2017) 8 pages
Module 8	• **Topic:** What are human stem cells, can you make them, and what can they be used for? • **Summary:** The development of induced human pluripotent stem cells (iPSCs) from somatic cells. Summary of how regulations for using human stem cells different between countries. Discussion of the ethical issues surrounding using human stem cells in human health. • **Required Readings/Works**: - "Embryonic stem cell research: A decade of debate from Bush to Obama" by Varnee Murugan (2009) 1 page - "National human embryo and embryoid research policies: a survey of 22 research-intensive countries" (2020) 12 pages. - Feel free to only read the "Discussion and Conclusion" and "Future Perspective" sections of this paper - "How Human Embryonic Stem Cells Sparked a Revolution" (2018) by David Cyranoski https://www.nature.com/articles/d41586-018-03268-4 - "Setting the standards – New stem cell research guidelines released" Megan Munsie and Melissa Little, International Society of Stem Cell Research (2021) 1 page. https://www.isscr.org/news-publicationsss/isscr-news-articles/blog-detail/stem-cells-in-focus/2021/08/05/setting-the-standards-new-stem-cell-research-guidelines-released • **Assigned work DUE by Sunday at 11:59 pm:** Quiz 7; Complete "mid-course improvement" survey. • **Optional reading:** - "A judge rules against one stem-cell clinic. There are hundreds of them" (2019) Denise Grady. The New York Times. https://www.nytimes.com/2019/06/10/health/stem-cells-fda.html - "The American stem cell sell in 2021: U.S. businesses selling unlicensed and unproven stem cell interventions" (2021) by Leigh Turner

Module	Topics, Homework, and Assignments
	https://www.sciencedirect.com/science/article/pii/S1934590921004203 - "Superstar athletes popularize unproven stem cell procedures" (2019) by Liz Szabo (Washington Post) ~3 pages. https://www.washingtonpost.com/health/2019/08/02/superstar-athletes-popularize-unproven-stem-cell-procedures/
Module 9	• **Topic:** The first human clone (?) and genetically modified humans. • **Summary:** The pathway to cloning/genetically modifying humans has been an international endeavor characterized by unsubstantiated claims of success, fraud, and ethical misconduct (including a prison sentence for one scientist). International policy of human cloning and how policies differ between countries will also be discussed. • **Required Readings/Works**: - **"**Cloning comeback" by David Cyranoski (*Nature* 2014) 4 pages - Read "Adopt a moratorium on heritable genome editing" by Eric Lander et al. (in *Nature*, 2019; 4 pages) - "CRISPR babies scientist He Jiankui should not be villainized – or headed to jail" by Josiah Zayner (2020) ~2 pages https://www.statnews.com/2020/01/02/crispr-babies-scientist-he-jiankui-should-not-be-villainized/ - The Code Breaker: Jennifer Doudna, Gene Editing, and the Future of the Human Race by Walter Isaacson - Part Six " CRISPR Babies" pages 299-332 • **Assigned work DUE by Sunday at 11:59 pm:** None • **Optional reading/videos:** - "A biohacker regrets publicly injecting himself with CRISPR" by Sarah Zhang (2018) ~3 pages. https://www.theatlantic.com/science/archive/2018/02/biohacking-stunts-crispr/553511/ - "The CRISPR shocker: How genome-editing scientist He Jiankui rose from obscurity to stun the world" by Sharon Begley and Andrew Joseph (2018) ~5 pages https://www.statnews.com/2018/12/17/crispr-shocker-genome-editing-scientist-he-jiankui/ - "Scientists create mice from two dads after making eggs from skin cells" https://www.cnn.com/2023/03/24/world/mice-eggs-from-male-cells-scn/index.html - Very well-done video about the fraudulent claims of the first human cloned embryo Part 1: https://www.youtube.com/watch?v=ett_8wLJ87U Part 2: https://www.youtube.com/watch?v=st6yupvNkVo
Additional Material	• Watch Dr. Harfe's video on "Presenting Data Professionally" (for the Team Project) • Watch Dr. Harfe's video on "Chatbots" • Watch the guest lecture by Dr. Paul Zehr, author of the "Chasing Captain America" book used in the course
Module 10	• **Topic:** *In vitro* fertilization (IVF) and Preimplantation genetic testing (PGT) • **Summary:** While genetic manipulation of the human genome is considered unethical by most of the world (see week 9 topic), techniques used to produce human embryos "*in vitro*" (i.e., embryos produced outside a human) is broadly acceptable in most countries.

Module	Topics, Homework, and Assignments
	• **Required Readings/Works**: • "How has IVF developed since the first "test-tube baby"?" by Adam Eley (2015; BBC) https://www.bbc.com/news/health-33599353 • "The ethical implications of preimplantation genetic diagnosis" moderated by Ann M. Gronowski (2014) 3 pages. https://academic.oup.com/clinchem/article/60/1/25/5581474 • "Is selecting better than modifying? An investigation of the arguments against germline gene editing as compared to preimplantation genetic diagnosis" by Hammerstein, Eggel and Biller-Andorno (2019) 11 pages. • Watch the movie GATTACA (1997; 1hr 46 minutes) by the Monday of week 13. • **Assigned work DUE by Sunday at 11:59 pm:** Quiz 8 and Discussion prompt 8. • **Class Assignment DUE by 11:59 pm on last day of course:** Final Paper, Reflections on human cloning, is assigned. • **Optional reading:** • "Genetic Intelligence Tests Are Next to Worthless" by Carl Zimmer, 2018 NY Times https://www.theatlantic.com/science/archive/2018/05/genetic-intelligence-tests-are-next-to-worthless/561392/ • "How Much Does IVF cost?" by Marissa Conrad and James Grifo (2021) *Forbes* https://www.forbes.com/health/family/how-much-does-ivf-cost/
Module 11	• **Topic:** Selection of a child's sex, and other traits, in humans without manipulation of the human genome. What happens to IVF embryos that are not implanted? • **Summary:** Views on IVF in various countries (and cultures) for selection of a child's gender, and other characteristics, will be discussed. Use of Preimplantation Genetic Testing (PGT) in avoiding inherited diseases. • **Required Readings/Works**: - The Code Breaker: Jennifer Doudna, Gene Editing, and the Future of the Human Race by Walter Isaacson - Part Seven " The Moral Questions" pages 335-365 - "From sex selection to surrogates, American IVF clinics provide services outlawed elsewhere" by Ariana Eunjung Cha (2018; The Washington Post) ~3 pages https://www.washingtonpost.com/national/health-science/from-sex-selection-to-surrogates-american-ivf-clinics-provide-services-outlawed-elsewhere/2018/12/29/0b596668-03c0-11e9-9122-82e98f91ee6f_story.html • **Assigned work DUE by Sunday at 11:59 pm:** Quiz 9 and Discussion prompt 9 • **Optional reading:** - "What should I do with my unused embryos" by Anna Hecker (2020) *The New York Times*. ~2 pages https://www.nytimes.com/2020/04/15/parenting/fertility/ivf-unused-frozen-eggs.html - "Disposition of unclaimed embryos: an ethics committee opinion" by Ethics committee of the American Society of Reproductive Medicine (2021) 6 pages

Module	Topics, Homework, and Assignments
	https://www.asrm.org/globalassets/asrm/asrm-content/news-and-publications/ethics-committee-opinions/disposition_of_abandoned_embryos-pdfmembers.pdf • **Class Assignment DUE by Sunday at 11:59 pm (F2F only):** "Clinical Case: Sex selection for non-health-related reasons" by Lusine Aghajanova and Cecilia Valdes (2012) 6 pages.
Module 12	• **Topic:** Discussion of the movie GATTACA and reflections on how this more than two decade-old movie's central theme holds up in today's scientific environment. Explanation of how ancestry DNA testing companies work. Discussion of Newborn screening. • **Summary:** Before the human genome was sequenced, CRISPR was developed, and the first animal clone was presented to the world, Hollywood gave us a story about a man who dreamed of going to the stars but was deemed genetically defective. Using the knowledge gained in this course, do you think the science in GATTACA is possible? Should a person be able to change their DNA to reach their dreams? • **Required Readings/Works**: - "Environmental DNA can be pulled from the air" by Amanda Heidt (2021. *The Scientist*) ~2 pages. https://www.the-scientist.com/news-opinion/environmental-dna-can-be-pulled-from-the-air-68645 - The Code Breaker: Jennifer Doudna, Gene Editing, and the Future of the Human Race by Walter Isaacson - "The Nobel Prize" and "Epilogue" pages 469-481 • **Assigned work DUE by Sunday at 11:59 pm:** Quiz 10 and Discussion prompt 10. • **Optional reading:** - "Neonatal screening in Europe revisited: An ISNS Perspective on the Current State and Development since 2010" by Loeber et. al. (2021), *Int J Neonatal Screen* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8006225/ - "The Newborn Heel Stick Test" by Marygrace Taylor (2021) https://www.whattoexpect.com/first-year/the-heel-stick-test.aspx • **Class Assignment DUE by Sunday at 11:59 pm:** A curious result using Ancestory.com
Module 13	• **Topic:** Presentations of team projects • **Summary:** Students will present their team projects on the ethics of cloning. Please note that this assignment must include a discussion of how different cultural views and/or international regulations may affect the implementation of the team's proposed policies (see grading rubric and "V. Quest Learning Experiences"). • **Required Readings/Works**: None • **Assignment:** None • **Assigned work DUE by Sunday at 11:59 pm:** None
Module 14	• **Topic:** Potential careers in fields related to this course • **Summary:** Complete human cloning and global awareness surveys. Reflection on your views of human cloning and the manipulation of the human genome. Potential careers in fields related to this course will be discussed (if you found the course content interesting).

Module	Topics, Homework, and Assignments
	• **Assigned work DUE by Sunday at 11:59 pm:** Final Paper: Reflections on human cloning (due by 11:59 on the day of the last in person class meeting). • **Optional reading:** - "25 Careers in Biotechnology to Explore (with salaries)" The Indeed Editorial Team (2022) https://www.indeed.com/career-advice/finding-a-job/biotechnology-careers - "In-Demand Biotechnology Careers Shaping Our Future" by Shayna Joubert (2018) https://www.northeastern.edu/graduate/blog/biotechnology-careers/ - this is basically an ad for Northeastern University, but has some useful information

IV. Student Learning Outcomes (SLOs)

At the end of this course, students will be expected to have achieved the Quest learning outcomes as follows:

Content: *Students demonstrate competence in the terminology, concepts, theories, and methodologies used within the discipline(s).*

- Identify, describe, and explain the ways that human cloning and genetics are currently being used both in the US and internationally (Quest 2, N). **Assessments:** Participation in class discussions, complete weekly quizzes that contain questions about assigned material and lectures, participation in weekly canvas-based discussions, and a final paper.
- Identify, describe, and explain the ways that human cloning and the genetic manipulation of human DNA has impacted human society. (Quest 2, N) **Assessments:** Participation in class discussions, complete weekly quizzes that contain questions about assigned material and lectures, participation in weekly canvas-based discussions, final paper.

Critical Thinking: *Students carefully and logically analyze information from multiple perspectives and develop reasoned solutions to problems within the discipline(s).*

- Critically analyze, evaluate, and compare US and international policy on human cloning and the genetic modification of humans. (Quest 2, N) **Assessments:** Participation in class discussions, assignments such as questions about the reading, and the team project.
- Critically assess what is currently possible in human cloning and genetics, and evaluate possible ethical issues that will arise from future discoveries. (Quest 2, N) **Assessments:** Discussion questions about the reading and film assigned, Team project, final paper
- Critically interpret global and intercultural issues in human cloning (Quest 2, N). **Assessments:** Personal views of global awareness survey, final project.
- Analyze how generative AI can be used and evaluate the weaknesses and strengths of this developing technology. **Assessments:** final project.

Communication: *Students communicate knowledge, ideas and reasoning clearly and effectively in written and oral forms appropriate to the discipline(s).*

- Communicate in writing and orally on how you can incorporate your knowledge of human cloning to educate the public on the benefit and risks associated with this evolving area of public health. (Quest 2, N) **Assessments:** Team project policy paper, final project.
- Effectively communicate with members of other cultures. (Quest 2, N) **Assessments:** Personal views of global awareness survey, group project

Connection: *Students connect course content with meaningful critical reflection on their intellectual, personal, and professional development at UF and beyond.*

- Reflect on what you have learned in the course and develop a way to connect with the public on these issues. (Quest 2) **Assessments**: Team project and policy paper.
- Reflect upon how you can incorporate your knowledge of human cloning in your future health. (Quest 2) **Assessments:** Final paper

V. Quest Learning Experiences

1. Details of Experiential Learning Component

Cloning policy paper – Team project

The course will include a group project in which student teams will choose **one** of the below three projects to complete. Student teams will be composed of 4-6 students. Each team member will produce a two-page (double-spaced) response to the prompt (this portion will be graded individually). The team will produce a one-page "policy paper" stating the specific regulations and conditions that would be put in place to ensure that their decision is abided by and a group presentation (see below and grading rubric; this is the team portion of the project and each team member will receive the same grade for this part of the project).

1. Determine if we should or should not move forward with creating a modern-day version of Captain America. The team's decision should be justified in two double-spaced typed pages. Next, the team will produce a one-page "policy paper" stating the specific regulations and conditions that would be put in place to ensure that their decision is abided by.
2. Determine if we should or should not clone ourselves. The team's decision should be justified in two double-spaced typed pages. Next, the team will produce a one-page "policy paper" stating the specific regulations and conditions that would be put in place to ensure that their decision is abided by.
3. Determine if we should or should not clone our organs. The team's decision should be justified in two double-spaced typed pages. Next, the team will produce a one-page "policy paper" stating the specific regulations and conditions that would be put in place to ensure that their decision is abided by.

Teams should address technical problems and ethical issues present in each of the above questions. How different cultural views and/or international regulations may affect the implementation of the team's proposed policies should be addressed (also see grading rubric). The project is due in week 14. Presentations will occur in person during class meeting times (either during the course lecture meeting times or in your breakout section).

Extracting DNA from strawberries (Module 2)

Strawberries contain eight (!) copies of each of their chromosomes. This makes them excellent starting materials for extracting DNA. In this experiment, using household (or dorm) items, you will extract DNA from strawberries following the procedure found here: https://www.genome.gov/Pages/Education/Modules/StrawberryExtractionInstructions.pdf

*this project can be performed individually or as a team of TWO. Teammates will receive the same grade. Each teammate should upload, individually, the same pictures (see grading rubric, above).

Visit "Dolly," the world's first cloned animal, "Tracy," a transgenic ewe genetically modified to produce a human protein and the original Watson and Crick model of DNA.

Students will virtually visit Dolly (https://www.nms.ac.uk/explore-our-collections/stories/natural-sciences/dolly-the-sheep/; this activity will be incorporated into the curriculum of Week 7), the Watson and Crick model of DNA https://collection.sciencemuseumgroup.org.uk/objects/co146411/crick-and-watsons-dna-molecular-model-molecular-model; this activity will be incorporated into the curriculum of Week 1, and Tracy, a transgenic ewe, genetically modified to produce a human protein (alpha antitrypsin) in her milk https://collection.sciencemuseumgroup.org.uk/objects/co482400/tracy-a-transgenic-sheep-sheep; This activity will be incorporated into the curriculum of Week 7.

OPTIONAL Study Abroad trip: UF in the UK: Exploring Science

*This is a separate one-credit course. Students do not have to have taken/be concurrently taking this Quest 2 course to register for the Study Abroad trip. The trip is open to any UF student.

Students will have the opportunity to travel to England and Scotland. On this trip, students will visit London, Edinburgh, and Glasgow. The trip will include the opportunity to visit Dolly, the world's first cloned animal (Edinburgh, Scotland) and see the original Watson and Crick model of DNA (London, England). The study abroad trip is an optional one-credit course and is not part of the above Quest 2 course.

Students that participate in the study abroad trip will explore two universities, the University of Glasgow and the University of London (UCL), which they can apply to attend the following year as exchange students (both exchange programs are run by Dr. Brian Harfe and are already established. See: https://www.advising.ufl.edu/beyond120/clas-exchange-programs/ for more info). The opportunity to spend a semester/academic year abroad is available to all students, irrespective of whether they participate in the Study Abroad trip.

Tentative Schedule for the Study Abroad trip (Spring 2026)

Sunday May 3rd (Edinburgh, Scotland):

- AM: Arrive in Edinburgh, Scotland (we will take the Edinburgh tram from the airport to the hotel)
- PM: Group lunch and orientation to Edinburgh (Dr. Harfe)
- PM: Explore the city! (hotel in Edinburgh).

Monday, May 4th (Edinburgh, Scotland):

- 9:30 am: Visit Edinburgh Castle

- PM: Visit the National Museum of Scotland. At the museum, see Dolly, the first cloned animal.
- In the evening, you have free time to explore the Royal Mile and Edinburgh (hotel in Edinburgh).

Tuesday, May 5th **FREE DAY** (*students are responsible for the cost of activities this day. I have put some suggestions below)

Suggestions for trips/things to do (so many possibilities!):

- Tripadvisor day trip suggestions (an excellent place to get some ideas)
- Day trip to the Highlands of Scotland, including visiting Urquhart Castle and Loch Ness! Several students went on this trip previously (~$75)
- Day trip to Aberdeen, Scotland, including Aberdeen University, where you can (through UF) spend the entire semester or academic year if you would like! (round-trip train is ~$110).
- Day trip to Newcastle University, where you can (through UF) spend the entire semester or academic year if you would like! (round-trip train is ~$50).
- Stirling, Scotland, and Stirling Castle (round-trip train is ~$30)
- St. Andrews, Scotland. Home of golf, an amazing (ruined) Cathedral, and a vibrant town. (round-trip train is ~$30. Keep in mind the train stop is called "Leuchars" which is outside of town).

Wednesday, May 6th (Glasgow, Scotland):

Day trip to Glasgow (1-hour train ride from Edinburgh to Glasgow).

- AM: Guided walking tour of Glasgow University. You can apply (through UF) to spend the entire academic year here if you would like (or a semester)!
- AM: Visit The Hunterian Museum, located on the University of Glasgow Campus. The Hunterian Museum includes permanent exhibits on "Medicine in Glasgow – Past and Present" and "Lord Kelvin: Revolutionary Scientist."
- PM: Explore Glasgow City Centre (shopping!). In the evening, take the train back to Edinburgh (hotel in Edinburgh)

Thursday, May 7th (London, England):

- AM: Train to London (4.5 hours). Arrive at London Kings Cross Station. Yes, there is a Platform 9 ¾.
- PM: Orientation to London and explore the city on your own.

Friday, May 8th (London, England):

- AM: British Museum (lunch at museum or surrounding area)
- PM: Walking tour of the University of London (UCL) for students interested in attending UCL as a UF exchange student. Or explore the city on your own.

Saturday, May 9th (London, England):

- AM: Visit the Science Museum, London. This is an incredible place with exhibits spanning the COVID pandemic to one of the world's oldest clocks (from the 1300s). At the museum, see:
    - The original Watson and Crick model of DNA.
    - The "most significant medical collection in the world."
    - The museum also has an outstanding selection of early microscopes and computers!

    - And one of the world's most famous exhibits on all things "Space" (as in exploring places not on Earth).
- PM: Explore the city on your own.

Sunday (May 10th): Fly from London home.

2. Details of Self-Reflection Component

"Any sufficiently advanced technology is indistinguishable from magic" ("Hazards of Prophecy: The Failure of Imagination" Arthur C. Clarke 1962).

The above quote is 60+ years old, but it perfectly represents how many people in the world view human cloning and the manipulation of human DNA. And "magic" can be scary. For example, a person who does not understand what the terms "genetic engineering" or "cloning" mean may immediately think of the monsters popularized in literature and the movies (i.e., Frankenstein's monster). During the first week of the course, students will be asked to reflect on their thoughts regarding the cloning/genetic modification of humans and complete an anonymous survey. The course will culminate with a final paper in which each student will reflect on what they have learned in the course and how their views have changed, or not changed, regarding the cloning/genetic modification of humans.

VI. Required Policies

Attendance Policy

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Students Requiring Accommodation

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

UF Evaluations Process

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Counseling and Wellness Center

Contact information for the Counseling and Wellness Center: http://www.counseling.ufl.edu/ , 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

The Writing Studio

The writing studio is committed to helping University of Florida students meet their academic and professional goals by becoming better writers. Visit the writing studio online at http://writing.ufl.edu/writing-studio/ or in 2215 Turlington Hall for one-on-one consultations and workshops.

In-Class Recordings

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the

publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Can we design "better" humans? Should we?

Final assignment

During the semester, you have learned a lot about cloning/genetic modifications of humans. In your final paper, you will discuss what data you need to be presented with to change your views of cloning and/or the genetic modifications of humans. **The first draft of the paper was written using a chatbot!** As you learned in this course, chatbots can create essays on many different topics. For the final assignment, you will use the chatbot-generated first draft of your essay.

Essay Prompt (read the instruction below before you start!):

State your view on human cloning and the genetic modification of humans.

1. Discuss two ways that human cloning could be used to improve human health and/or be detrimental to human health.
2. Discuss two ways that human genetic engineering could be used to improve human health and/or be detrimental to human health.

Arguments should be strongly supported by evidence, using persuasive language. Arguments should critically evaluate your position using sources in the literature.

The essay must contain at least three references. The literature used must be cited within your essay and included in a separate section titled "References" at the end of the essay (references can be written in any format).

Include a concluding summary discussing what you believe will occur in the next ten years in the field of human cloning and the genetic modifications of humans.

There is no word limit.

Instructions: See the Canvas course page.

GRADE BREAKDOWN

% of Final Grade	Course Component
5%	Course surveys
6%	Initial thoughts on human cloning Paper
10%	Discussions in Perusall
15%	Human cloning team project
20%	Weekly quizzes
20%	Reflections on human cloning Final Paper
24%	Assignments

Please note that all Assignments for the week should be completed **before** attempting the weekly Quiz. The weekly Quiz can only be taken once and contains questions from the material presented in the week's lectures and from the week's assigned material.

GRADING SCALE

Percent	Grade	Grade Points
94 - 100%	A	4.00
90 - 93%	A-	3.67
87 - 89%	B+	3.33
84 - 86%	B	3.00
80 - 83%	B-	2.67
77 - 79%	C+	2.33
74 - 76%	C	2.00
70 - 73%	C-	1.67
67 - 69%	D+	1.33
64 - 66%	D	1.00
60 - 63%	D-	0.67
<60%	E	0.00

See the current UF grading policiesLinks to an external site. for more information.

Grade Rounding

Final grades will be rounded **up** to the nearest whole number. For example, if your final grade is 93.5, I will round up to an "A"; however, if your final grade is 93.4, it will be an "A-." No exceptions will be made.