



CLONES & GENOMES – USEM 1580 – FALL 2016 (06/29/16)

Course Description

“The cloning of humans is on most of the lists of things to worry about from science, along with behavior control, genetic engineering, transplanted heads, computer poetry and the unrestrained growth of plastic flowers.”

Lewis Thomas (1913-1993) Physician, cancer researcher and self-described Biology Watcher.

“Sex will always be the preferred way of having children. Cloning is...far too expensive and a lot less fun than the original method.”

Keith H. Campbell (1954-2012) Developmental biologist and co-creator of Dolly.

“The role of the scientist is to break the laws of nature.”

Steen Willadsen (1941-) Developmental biologist and first to clone a mammal from embryonic cells.

“Common sense tells us that if scientists find ways to greatly improve human capabilities, there will be no stopping the public from happily seizing them.”

James D. Watson (1928-) Co-recipient with Francis Crick and Maurice Wilkins of the 1962 Nobel Prize in Physiology or Medicine for determining the double helical structure of DNA.

Do human clones already exist? What’s the difference between reproductive and therapeutic cloning? Can deceased or even extinct animals be cloned? Who has the right to know *your* DNA sequence? Can gene therapy be performed in human embryos? What is our current understanding of these fascinating and controversial questions (and more!) and what are the experimental approaches used to answer them? Welcome to Clones & Genomes: New Biology.

Course Objectives

The overall goals of this USEM are for you to:

1. Gain an understanding of contemporary research in reproductive and therapeutic cloning, stem cell research and the applications of these rapidly advancing fields to the treatment of diverse human diseases.
2. Understand the enormous impact of the human genome sequence on genetic testing and the diagnosis and treatment of genetic diseases.
3. Consider these topics from scientific, historical, ethical, religious and societal perspectives and in doing so, appreciate the importance of scientific literacy in today’s society.

Meeting Time and Location 2:00 – 3:50 PM Weds. Physical & Life Sciences Bldg. (PLSB) 200.

Instructor Information

Mike Wormington, Associate Professor of Biology and National Academies Education Fellow in the Life Sciences. My hometown is Overland Park, Kansas, and I attended the University of Kansas (Rock Chalk Jayhawks!) where I earned my BA with Honors in Biology and my PhD in Biochemistry. I was an NIH Postdoctoral fellow at the Carnegie Institution for Science, Dept. of Embryology, in Baltimore, MD. I joined the UVa Biology faculty in 1989 and have taught our BIOL 3000 Cell Biology core class since 1992 and this USEM since 1998. I also teach an advanced cellular mechanisms course that uses a case study approach to investigate the cellular processes underlying diverse diseases and their associated molecular components that may serve as new therapeutic targets. My longstanding research interest is the regulation of gene expression during oogenesis and embryogenesis and the interplay between genetic and metabolic reprogramming. When I'm not in the lab or teaching, I spend my time with my wife Susan, who is the Art Director at UVa's Darden School of Business. We also enjoy being with our two daughters and sons-in-law and our two grandchildren (#3 scheduled to arrive in September!). I'm also a search and rescue, disaster relief mission pilot and director of operations for the Virginia wing of the US Civil Air Patrol which is the civilian auxiliary of the United States Air Force.

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Office Hours: By appointment. Just email or let me know in person you'd like to chat & we can set up a meeting.

Collab Website

The USEM 1580 Collab Course site is an important resource that you will use to access and download the assigned readings. The Resources section will contain pdf files of assigned readings and any pertinent powerpoint slides for each unit of the course. These readings will come from essays, review articles, primary research papers, and two out of print books; *Clone: The Road to Dolly and the Path Ahead* by Gina Kolata; and *Bioethics and the New Embryology* by Scott Gilbert, Anna Tyler and Emily Zackin. Each reading assignment will have an associated list of questions that will serve as the basis for class discussions. Since this is a discussion-based course, you will be expected to complete the assigned reading and go over the pertinent questions *before* the class in which they will be covered. Bring either printed copies or your laptop or tablet with the electronic files to class so you can refer to them as necessary during discussions.

Course Format

I will typically begin each topic with an overview to introduce new concepts, terminologies, and methodologies. You will then break up into your small groups (~6 students each) where you will discuss each reading assignment using the associated questions as prompts. Time permitting we'll then reconvene the entire class to collectively share each group's perspectives, questions, and comments. I will organize the groups once the class roster "settles" after the add/drop deadline. You will work in the same group throughout the semester. Many of the topics we will discuss are necessarily controversial (e.g., when does life begin? the use of human embryos to derive embryonic stem cells, pre-implantation genetic testing), and you may disagree with many scientific methodologies and their applications for any of a number of completely valid ethical, moral, political or religious reasons. That's fine. However, the goal of this course is for you to understand and appreciate the underlying science and diverse perspectives you will encounter with these topics. You don't need to agree with them, but you do need to understand them. Science *per se* is intrinsically amoral (i.e., neither good nor bad). That said, the scientific

community bears enormous responsibility to envision how advances can be applied and educating the public accordingly. We will discuss several examples where reproductive and genetic technologies have been beneficially applied and conversely, where their misuse resulted in horrific consequences. However, you'll see that it is generally impossible to discern when a given avenue of research leads down the proverbial "slippery slope" to where it should have been stopped. Nobody will be criticized for sharing their opinions or disagreeing with points made in the various articles or by your classmates or me. We will always show the greatest respect and consideration for everyone's opinions. Remember, the validity of an argument is not enhanced by the volume or intensity with which it is made. We would all do well to heed the following advice of the great journalist and social critic H.L. Mencken "Assume that your opponent is as decent a person as you are and just as honest, and perhaps, after all, right."

Evaluation and Grading

Unlike many of the courses you will take at UVa, this course does not have exams. Instead, my goal is for you to independently explore the topics we will consider and to actively participate in small group and entire class discussions. Your learning will be assessed by:

- **Attendance: 20% of course grade.**

You have to be here to participate. Attendance will be taken.

- **Participation in Discussion: 50% of course grade.**

You have to attend class and you have to participate once you're here. I know you have an opinion on virtually any given topic so here's your chance to express it freely. There will be a reading assignment for every class. You will be expected to contribute to small group and entire class discussions. Asking thoughtful questions contributes to discussions! You will email me a self-assessment score summarizing your overall participation each week using the following scale:

- 0 = unexcused absence from class; correlates to a letter grade of D
- 1 = attentive, but little or no contribution to discussions; correlates to a letter grade of C
- 2 = occasional productive contributions to discussions; correlates to a letter grade of B
- 3 = significant and active participation; correlates to a letter grade of A. *An assessment of "3" must include several sentences specifically describing your participation.*

- **Reports: 30% (3 X 10% ea.)**

You will be required to write three, 4 page (double-spaced) reports presenting a balanced synopsis of the various scientific and ethical perspectives concerning 3 of the main topics discussed in class. Details on the format & points to address in the reports will be provided during the semester. You'll have at least a week to complete each report after it is assigned.

- Report I: The science & ethics of cloning **Due TBA**
- Report II: The science & ethics of stem cell research **Due TBA**
- Report III: The science & ethics of utilizing the human genome **Due TBA**

Important College Dates

- First Class: Weds. Aug. 24
- Add Deadline: Tues. Sept. 6
- Drop Deadline: Weds. Sept. 7
- Withdrawal Deadline: Tues. Oct. 18
- Thanksgiving Break: Weds. Nov. 23 & Fri. Nov. 25
- Last Class: Weds. Nov. 30

USEM 1580 F16 – TOPICS FOR DISCUSSION

1. Historical origins & the biological premise for cloning. Experimental embryology in the 19th & 20th centuries. The impact of scientific misconduct on reproductive cloning.
2. The biology of somatic cell nuclear transfer (SCNT).
3. The science & ethics of human reproductive cloning.
4. Embryonic stem cell research, therapeutic cloning & induced pluripotent stem cells – Promises, Perils, Policies & Politics. The impact of scientific misconduct on therapeutic cloning and stem cell research. When does life begin?
5. 63 Years of DNA: Double helix to human genome.
6. Genes & politics: Eugenics & better living through genetic enhancement.
7. The science & ethics of somatic cell & germline gene therapy
8. The human genome: Genetic testing & DNA “ownership” .