

## Lecture #22 May 6, 2010: Cloning

Is biochemistry destiny?

Q: nature or nurture? A: Both!

Neurotransmitters such as serotonin, dopamine, and norepinephrine, can dramatically influence mood, personality, and attitude. Some proteins (cyclic-AMP response elements, or CREB) affect retention of memory and learning. Damage to the brain can affect not only memories and language skills but also personality.

Questions in the public discourse:

Are there genes that determine intelligence?

What about math skills?

Are women “genetically less capable of math” than men?

Is homosexuality genetic in origin? If so, what is the evolutionary advantage?

These questions naturally upset people. Often the questions are poorly formed.

For example, the variation among women and among men (or within various ethnic groups) is *much* larger than any alleged *average* differences between women and men.

Genetics and biochemistry in SF

Science fiction is a venue where myths, metaphors, and anxieties about genetics and biology can be discussed.

Who gets to decide which traits are important?

The movie *Gattaca* (1997). In *Gattaca*, genetic engineering itself is neither good nor evil. The evil is judging people *solely* on their genes.

Other examples:

John Varley's *The Ophiuchi Hotline*, set in a future where invading aliens have driven the human race off Earth and threaten us with extinction, is about arguments over the dangers and necessities of genetic engineering.

David Brin's *Startide Rising* (and related novels) has a galactic-wide tradition of “uplift,” whereby an advanced species genetically engineers other species (such as dolphins and chimps) with intelligence, who then work off their “debt” as servants for generations.

Biochemical tinkering are major themes in *Brave New World* and *Nekropolis* by Maureen F. McHugh.

Major themes of genetics and biochemistry in SF

How do we define “human”? Who gets to make that definition?

Do we have the right to change that definition?

What happens to those left behind by changes?

Clone = genetic copy.

3 different usages of the term “cloning”

[http://www.ornl.gov/sci/techresources/Human\\_Genome/elsi/cloning.shtml](http://www.ornl.gov/sci/techresources/Human_Genome/elsi/cloning.shtml)

(1) DNA cloning: copy a gene (or genes) and insert into another organism. This is what people think of as “genetic engineering.”

(2) Reproductive cloning. Creating an organism with the same (nuclear) DNA as another, adult organism. What most people think of as “cloning,” especially if from adult or somatic cells.

(3) Therapeutic cloning. Production of stem cells, often from embryos.

In normal reproduction, sperm + ovum = zygote. For reproductive cloning, one takes an oocyte (unfertilized egg) and removes the nucleus. One then inserts the nucleus from an adult somatic cell. (This is called “nuclear transfer.”) Because the genes of the adult somatic cell have already been expressed (tissue differentiation) this often doesn’t work!

[http://www.manitoulin.com/cloning/cloning\\_dolly.htm](http://www.manitoulin.com/cloning/cloning_dolly.htm)

We have cloned tadpoles (1952). Dolly was first clone of an adult *mammal*. 276 embryos were made to create **one** Dolly! Other cloned species include mice, goats, pigs, cats... and a dog (took over 1000 embryos to make).

It’s easy to clone plants—they do it all the time (vegetative reproduction).

(Animal) clones often have abnormalities in gene expression. Stem cells have not yet differentiated and thus are more plastic.

*If* we could better understand and control the process of gene expression, we could control differentiation and dedifferentiation. We might not even need stem cells. We might be able to get organs to regenerate themselves, the way starfish, and some reptiles and amphibians can regenerate limbs.

“Genetically engineered” people. One could introduce genes into the cell line, to produce desired traits.

### ***Chimeras***

Mythology: a creature with the head of a goat, a lion, and a serpent. (Also breathes fire). Inspired by mountain in Turkey where natural gas percolates to surface and burns. Slain by the “hero” Bellerophon, on the back of Pegasus.

In biology, a *chimera* is an organism with two (or more) populations of cells which are genetically distinct. Different tissues, even different organs, can be from different “parents” or even different species, such as the “geep” a combination of a goat and a sheep.

Could be created by mixing together the cells of two or more *morulas* (ball of undifferentiated, totipotent cells). Used in research to follow embryo development and differentiation of tissues.