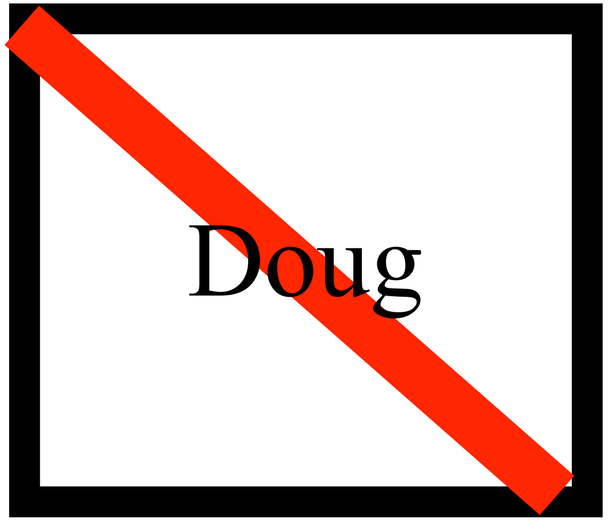
# 1. Clicker Attendance

- Launch your Top Hat app on your smart phone, or load the TopHat.com website, or text to the course phone number.

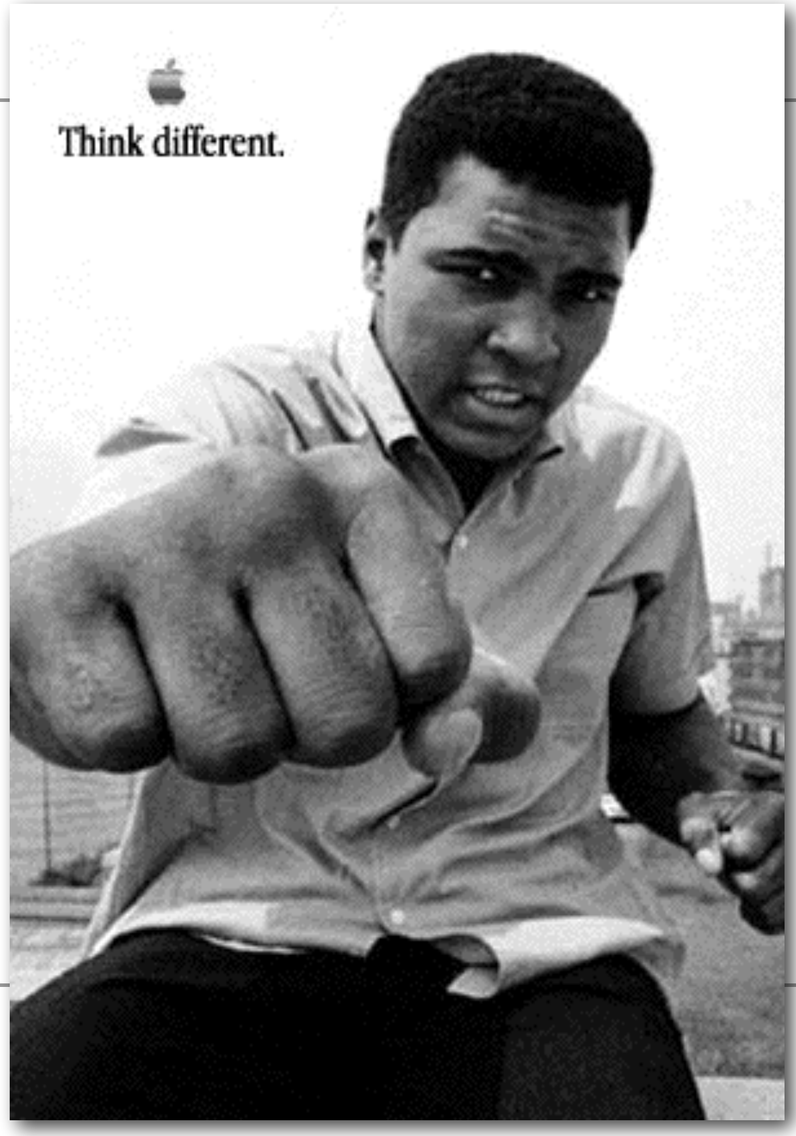
# 2. Hand in your Homework for today

# 3. To Opt-OUT of being called upon

- Name Card with red stripe means you Opt-OUT (can Opt-OUT 3 times)



# LB144-Pandemic *2022*




# Announcements

- **How we grade papers…**
- **Half-Draft Manuscripts** *improvement! T-shirt winners = soon*


# Announcements

- **How we grade papers…**
- **Half-Draft Manuscripts** *improvement! T-shirt winners = soon*
- ***Exam Part 1*** **DUE Sun. 11:59pm** to turnitin.com. Type words. Hand draw pics. Avoid giant photo file sizes.

  Beware: Showing answers to desperate people
- ***Part 2*** **in-class Mon Oct 31.** Mostly same essays from Part 1

Yes, and notecard. And Exam II score can elevate Exam I

When does PCR happen during the cell division?

**Lecture16 -** (Prepari

**Budgeting homewo**

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Chapter 3: ELSI 3.2

- Should we engineer better babies?

L.O. Evaluate Pros + Cons associated with genetically engineering human babies.

healthy children - Genome Project id 2000+ genetic diseases + now have 1000's + tests
some genetic tests claim id athletic gene, wait, what about food training etc?

In 1950's - social environment! since 2000 public believes DNA!

Those that believe in genetic determinism → shout save costs of healthcare with disease-free children, so prevent disease at genetic level.

Spina bifida avoided eating green vegetables during pregnancy yet screen for it.

Currently most common test at birth - Down syndrome (trisomy 21), cystic fibrosis, spina bifida. Down → not fatal, "different."

- Parents are aborting fetuses if trisomic 21 = Down's, is that OK?

In addition to three genetic diseases most states screen new borns for other disorders (~29). Becoming mandatory in some states yet not even FDA approved.

CF info, interesting comment: positive result using fetal cells, and typical genetic test for CF will be correct less than 30% of the time.
(result of false positives x many people will not have 508 mutation)

- Parents mandated to test then may be pressured if chose not abort.
"Financial interest of society"

Slippery slope → how far you go? Beethoven - hearing, Van Gogh - sight eyes, mental illness

Make super warriors if other country does? Minority Report

Males genetically violent/criminal - "Pre-crime division" Preemptive incarceration!

Forced sterilization → could become terrorists!

GATTACA

IQ 1. If could elimin genetic disease would you want your child? not work out same? CRISPR #HIV resistance
2. Compare Eugenics + screening MORE → 2018 China 2 girls

Perhaps you agree that genetic diseases should be eliminated whenever possible. How far do you think society should be willing to go to reach perfection? The composer Beethoven had deteriorating hearing, and the impressionist painter Van Gogh had glaucoma along with mental illnesses (ELSI Figure 3.2). Should we forego creative genius as a tradeoff for fewer diseases? If other nations start engineering designer babies, perhaps super warriors, is your country obliged to defend itself with similar genetic manipulations? *{Connections: Eugenics are discussed in ELSI 1.1 and ELSI 20.1.}* Some men have been described as genetically violent and predisposed to criminal acts. Should we use preemptive incarceration and forced sterilization to prevent crime and protect our way of life? Is it appropriate to protect our lives by aborting fetuses that might grow up to become terrorists?

**ELSI Figure 3.2** Impressionist painter Vincent Van Gogh. His famous way of seeing the world (in the self-portrait on the left) may have been the consequence of genetic imperfections. Photo of the artist (right) was taken in about 1886. Left: Public domain, via Wikimedia Commons; right Public domain, via Wikimedia Commons.

Many of these questions have been addressed in books such as *Brave New World* (1931) by Aldous Huxley and movies such as *Gattaca* (1997) and *Minority Report* (2002). You may not have formed an opinion yet because at this point in your life, you do not want to have children. But decisions are being made today that will affect your reproductive freedom and options. When you were born, there were a few genetic tests. Now there are many genetic tests. As a student of biology, you will be part of the public discussions that help society make these important decisions.

Written with the assistance of Kyri Bye-Nagel, Davidson, NC.

### Integrating Questions

1. If it were possible to eliminate a genetic disease by engineering babies, would want your child to have its genome manipulated as part of the curing process?
2. What are the similarities and difference between eugenics of the early twentieth century and current genetic screening of babies prior to birth?

### Explore More on genetic manipulation of human DNA

1. In October 2018, an American-educated, Chinese scientist produced the world's first genome-edited human babies. Two girls were born after having their genomes altered in hopes of making them resistant to HIV infection.
2. In August 2019, *Science* published a news item raising concerns for many of the unintended consequences of genome editing humans. The twin girls do not have the same edits because the editing machinery did not perform the same tasks in both fertilized embryos.

# What do you want to do next...?

**What you want today?** 1:00

What would you like to do next?

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| **B** | Talk more about Meiosis for 10 minutes |
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# Exam Q&A

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# Mitosis Meiosis etc

# 3.5: How can two parents produce non-identical offspring?

**Biology Learning Objectives**

- Describe the process of meiosis and its genetic outcomes.
- Compare and contrast meiosis and mitosis.

?

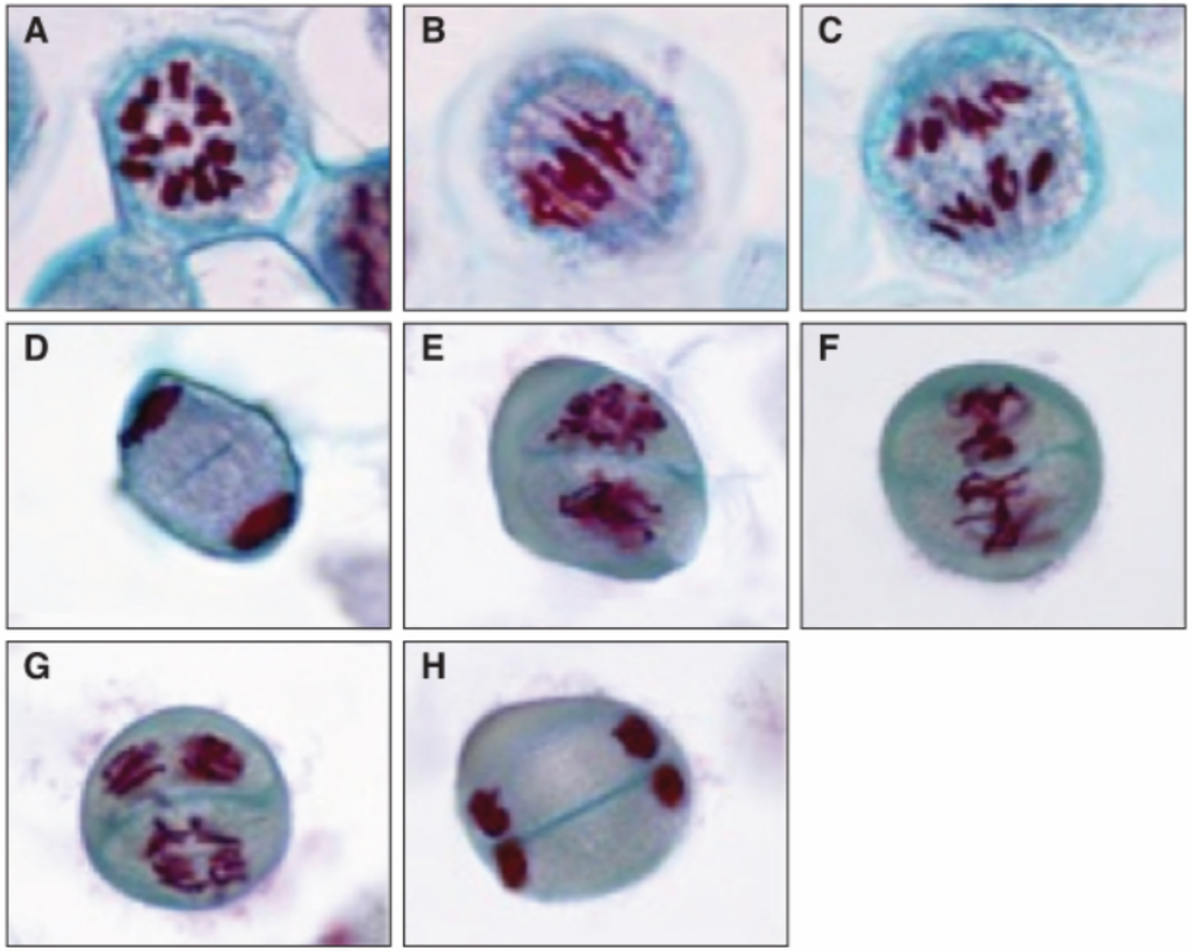



**Figure 3.22** Egg formation in a lily plant with DNA stained red. **A,** Parental diploid cell has already undergone DNA replication. **B,** Chromosomes condense and pair up with their matching chromosome. Each pair becomes closely intertwined, and then moves to the equator. **C,** Paired chromosomes separate and migrate to opposite poles. **D,** Cytokinesis separates the haploid

# Which stage and why?

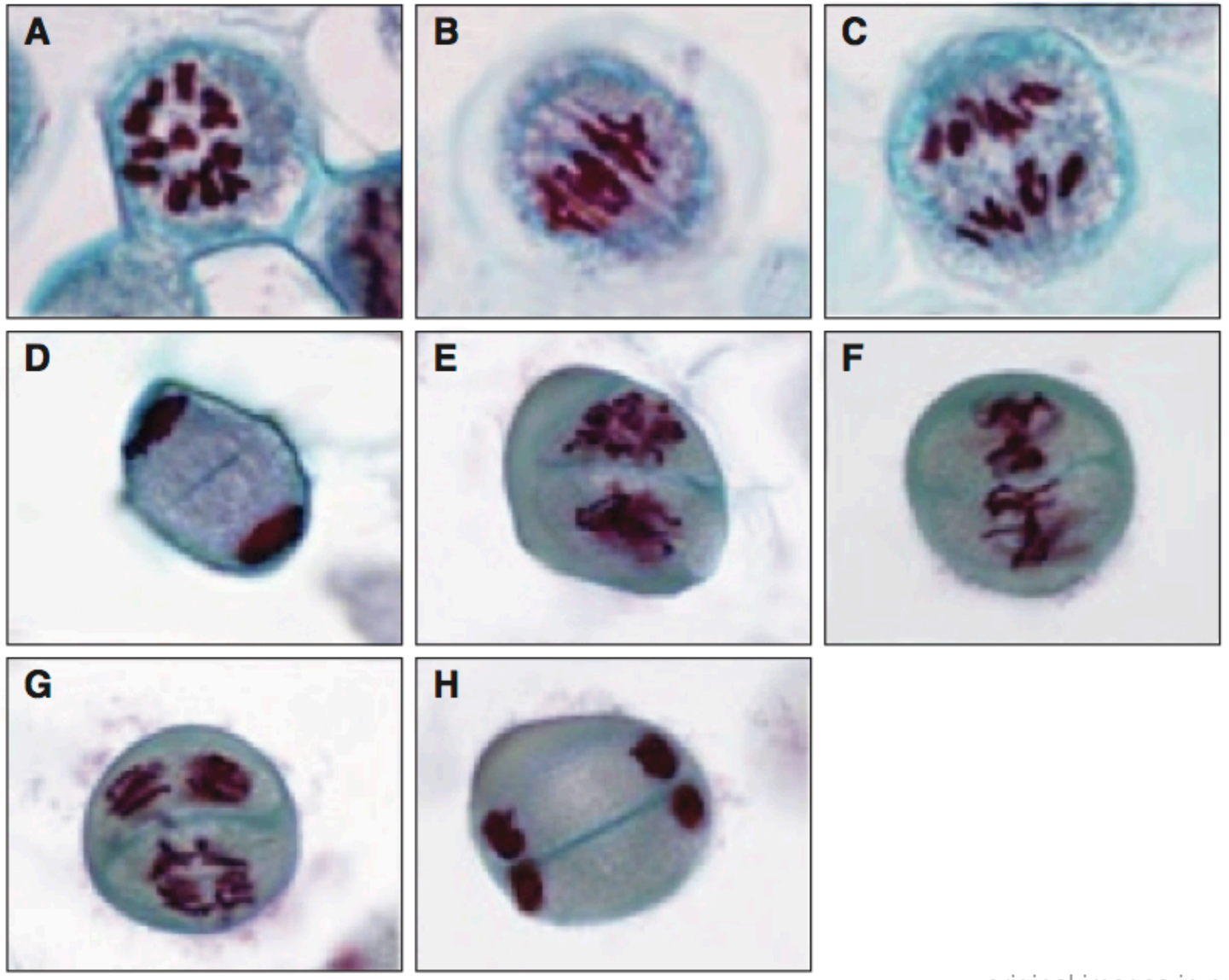



Fig. 3.22

# Preparing for Sexual Reproduction

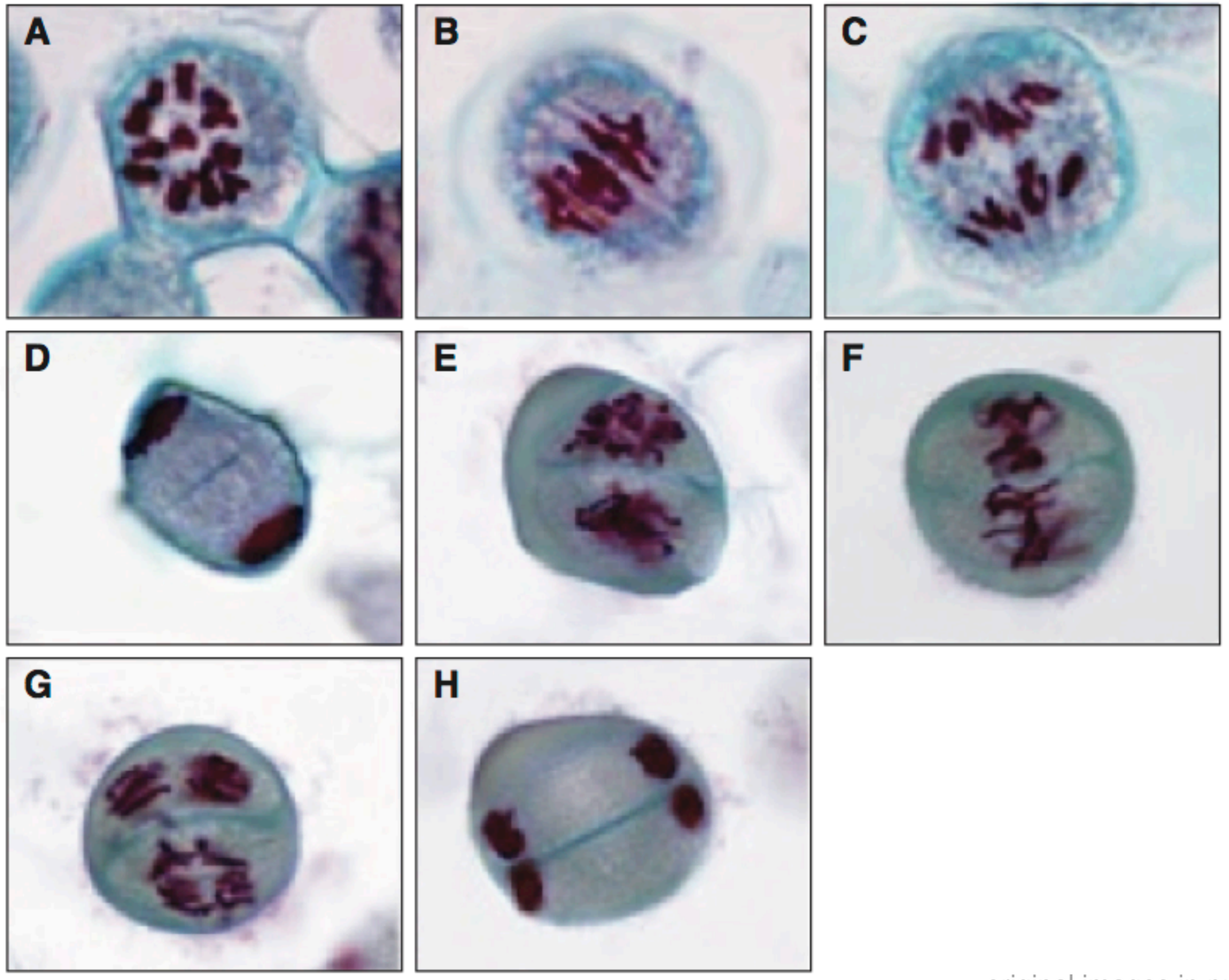
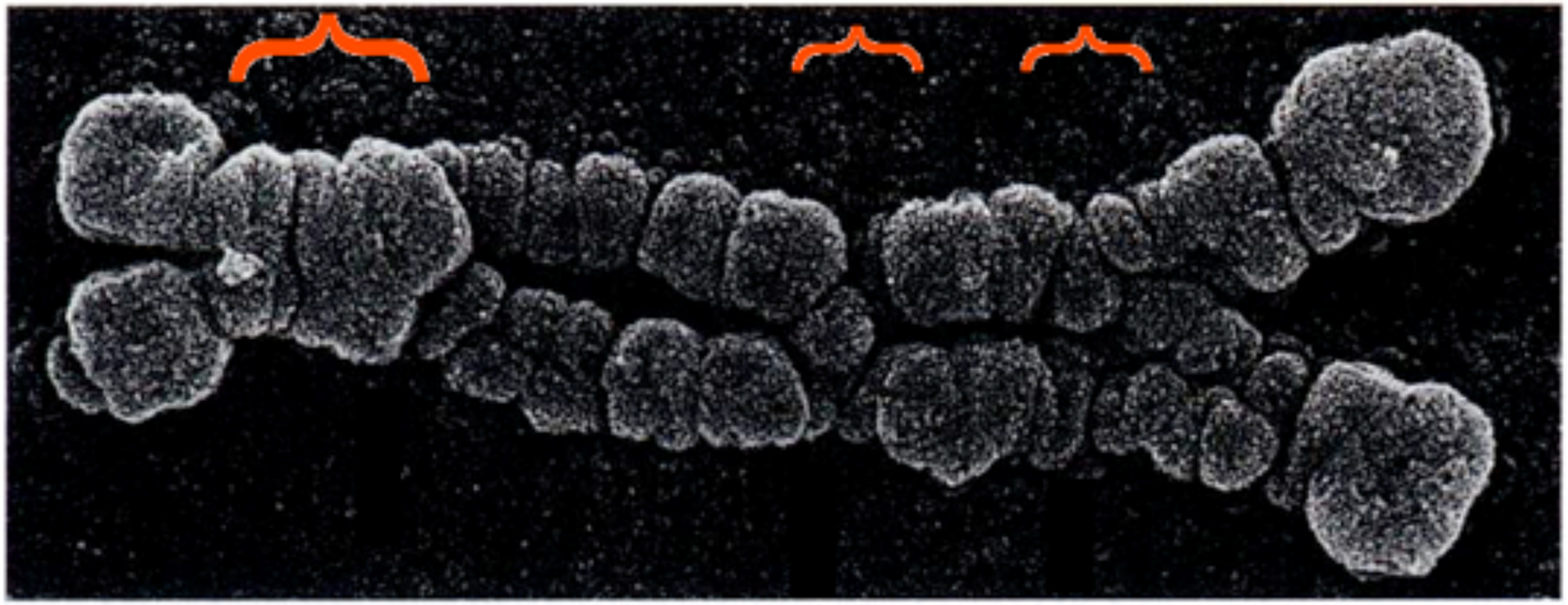



Fig. 3.22

# Pop-Trifecta



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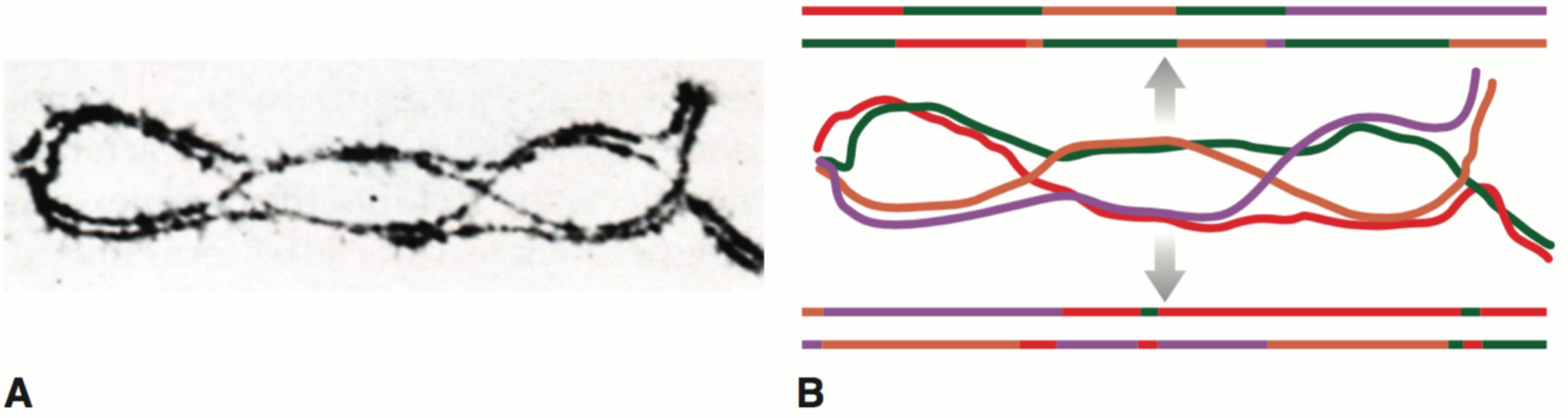
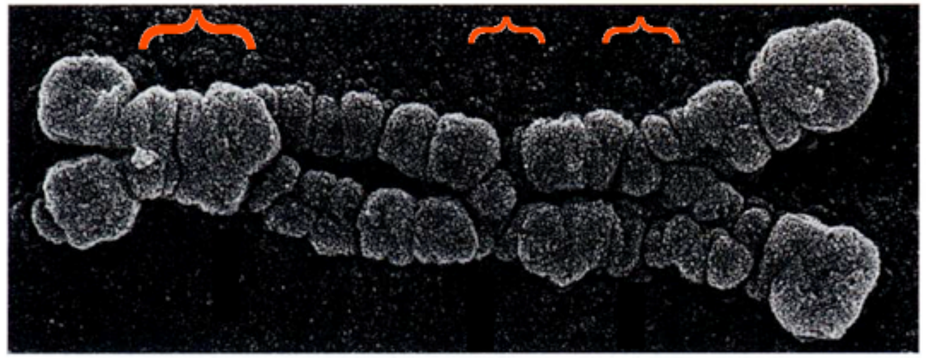



**Figure 3.23** Chromatids recombine during prophase I. **A,** Micrographs of four homologous chromatids crossing over, or recombining. **B,** Line drawing of A with the four resulting chromatids pulled apart as in anaphase I. A. Reprinted from Meiotic Crossing-over: Obligation and Interference. Gareth H.

# Chromatid Recombination

four chromatids during crossing over



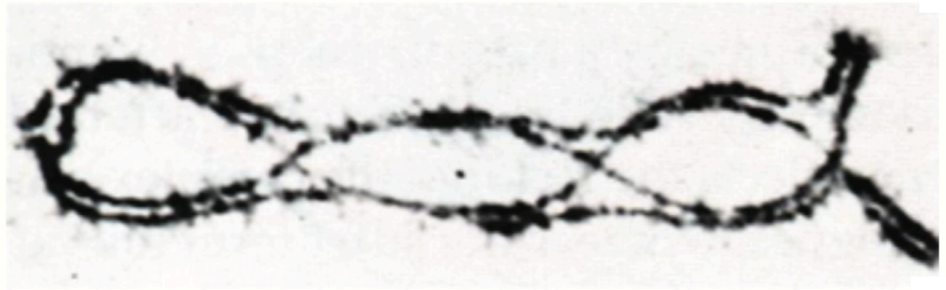
A

Fig. 3.23

A: from Jones and Franklin, 2006

# Chromatid Recombination

four chromatids during crossing over



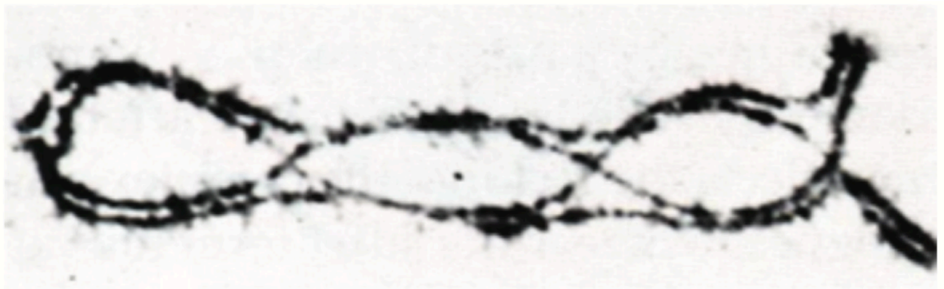
**A**

Fig. 3.23

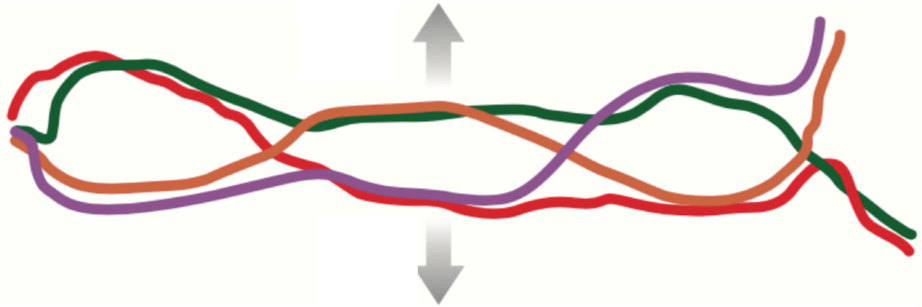
A: from Jones and Franklin, 2006

# Chromatid Recombination

diagram of these four chromatids



A



B

Fig. 3.23

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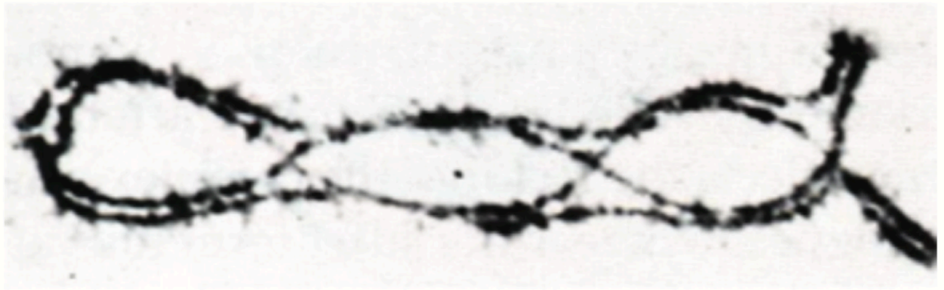

A

B

same four chromatids
pulled apart to show their
mosaic composition

Fig. 3.23

A: from Jones and Franklin, 2006

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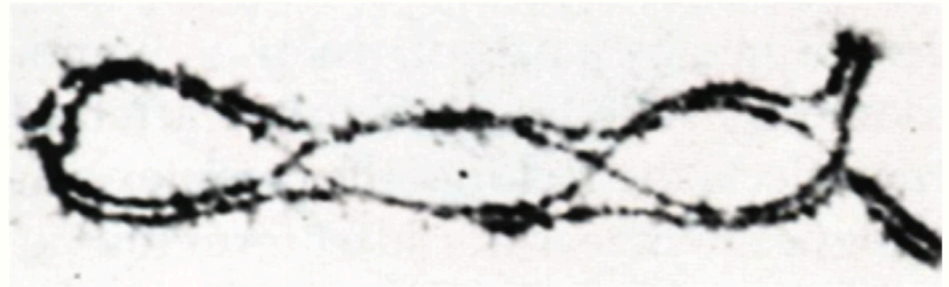

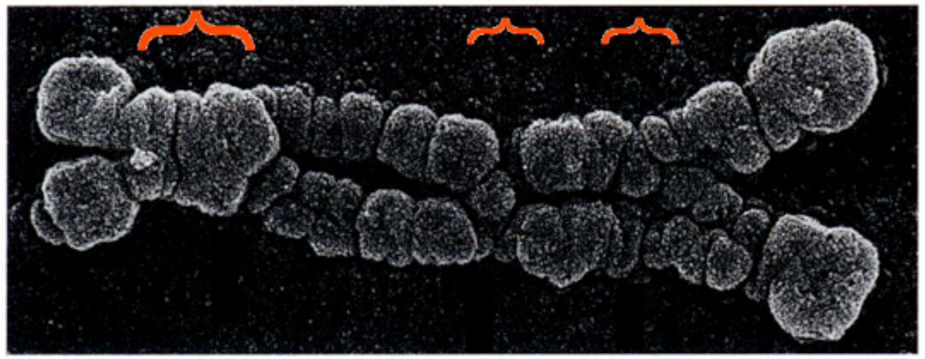

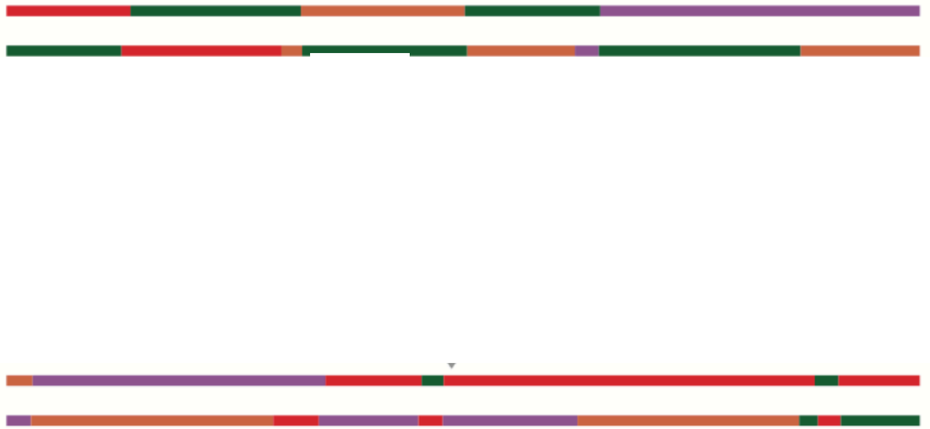

**B**

all 4 post-prophase I chromatids have content from each of the other pre-prophase I chromatids

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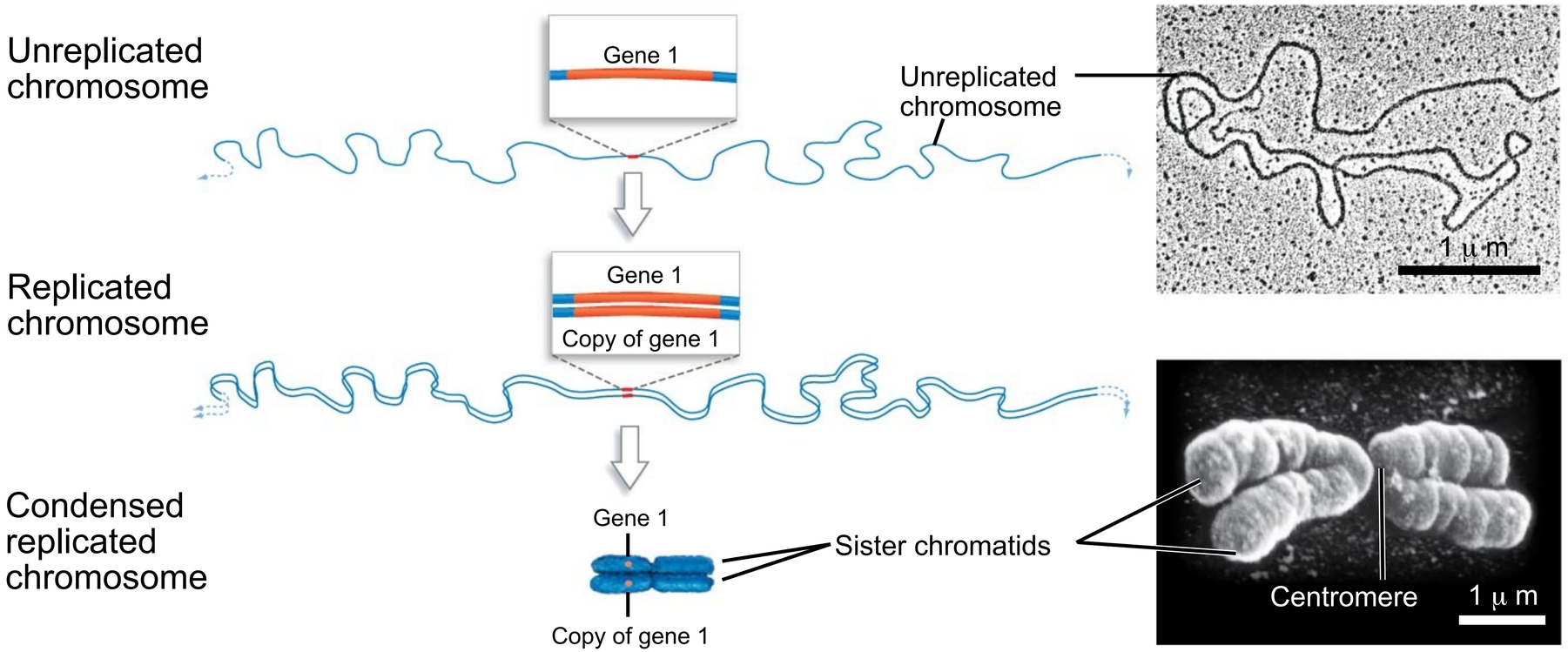
A: from Jones and Franklin, 2006

# To review...



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# ELSI Debate

# What is the cost of genetic perfection?

ELSI Fig. 3.2

http://www.vangoghgallery.com/in_his_steps/images/selfportrait.jpg

http://commons.wikimedia.org/wiki/File:Vincent_van_Gogh_photo_cropped.jpg

Perhaps you agree that genetic diseases should be eliminated whenever possible. How far do you think society should be willing to go to reach perfection? The composer Beethoven had deteriorating hearing, and the impressionist painter Van Gogh had glaucoma along with mental illnesses (ELSI Figure 3.2). Should we forego creative genius as a tradeoff for fewer diseases? If other nations start engineering designer babies, perhaps super warriors, is your country obliged to defend itself with similar genetic manipulations? *{Connections: Eugenics are discussed in ELSI 1.1 and ELSI 20.1.}* Some men have been described as genetically violent and predisposed to criminal acts. Should we use preemptive incarceration and forced sterilization to prevent crime and protect our way of life? Is it appropriate to protect our lives by aborting fetuses that might grow up to become terrorists?

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He Jiankui presented a slide at a Hong Kong, China, genome-editing summit that showed DNA sequences from the edited *CCR5* genes in the twin girls.

NATIONAL ACADEMIES/FLICKR ()

*This story, one in a series, was supported by the Pulitzer Center.*

Since the gene-edited babies known as Lulu and Nana became international news in November 2018, scientific debate and media speculation have swirled around the potential impacts of modifying their gene for *CCR5*. One recent study prompted the *MIT Technology Review* to suggest the twins have enhanced memories and learning abilities, leading to copycat stories worldwide that exercised less restraint. And in June, drawing on a population analysis of variants of the gene *CCR5* published in *Nature Medicine*, headlines blared that the girls might have shortened lives. "This interpretation is not valid or responsible," Rasmus Nielsen, a geneticist at the University of California (UC), Berkeley, who led the work, countered in a tweet.

A major concern has been that He Jiankui's attempts to cripple *CCR5*, the gene for a protein on immune cells that HIV uses to infect the cells, also made "off-target" changes elsewhere in the girls' genomes. Those changes could cause cancer or other problems. He contends that the babies have no such off-target mutations, although some scientists are skeptical of the evidence offered so far.

People inherit two copies of *CCR5*, one from each parent. He chose the gene as a target because he knew that about 1% of Northern European populations are born with both copies missing 32 base pairs, resulting in a truncated protein that doesn't reach the cell surface. These people, known as *CCR5Δ32* homozygotes, appear healthy and are highly resistant to HIV infection.

In the embryos He's team edited, the researchers did not attempt to delete these exact 32 base pairs; rather, the group designed CRISPR to cut *CCR5* at the base pair at one end of the natural deletion. The error-prone cell-repair mechanism, which CRISPR depends on to finish knocking out genes, then deleted 15 base pairs in one of Lulu's copies of the gene, but none in the other. With one normal *CCR5*, she is expected to have no protection from HIV. Nana, according to the data He presented in a slide at an international genome-editing summit held in November 2018 in Hong Kong, China, had bases added to one *CCR5* copy and deleted from the other, which likely would cripple both genes and provide HIV resistance.

**CRISPR in China**

Read more from our special series.

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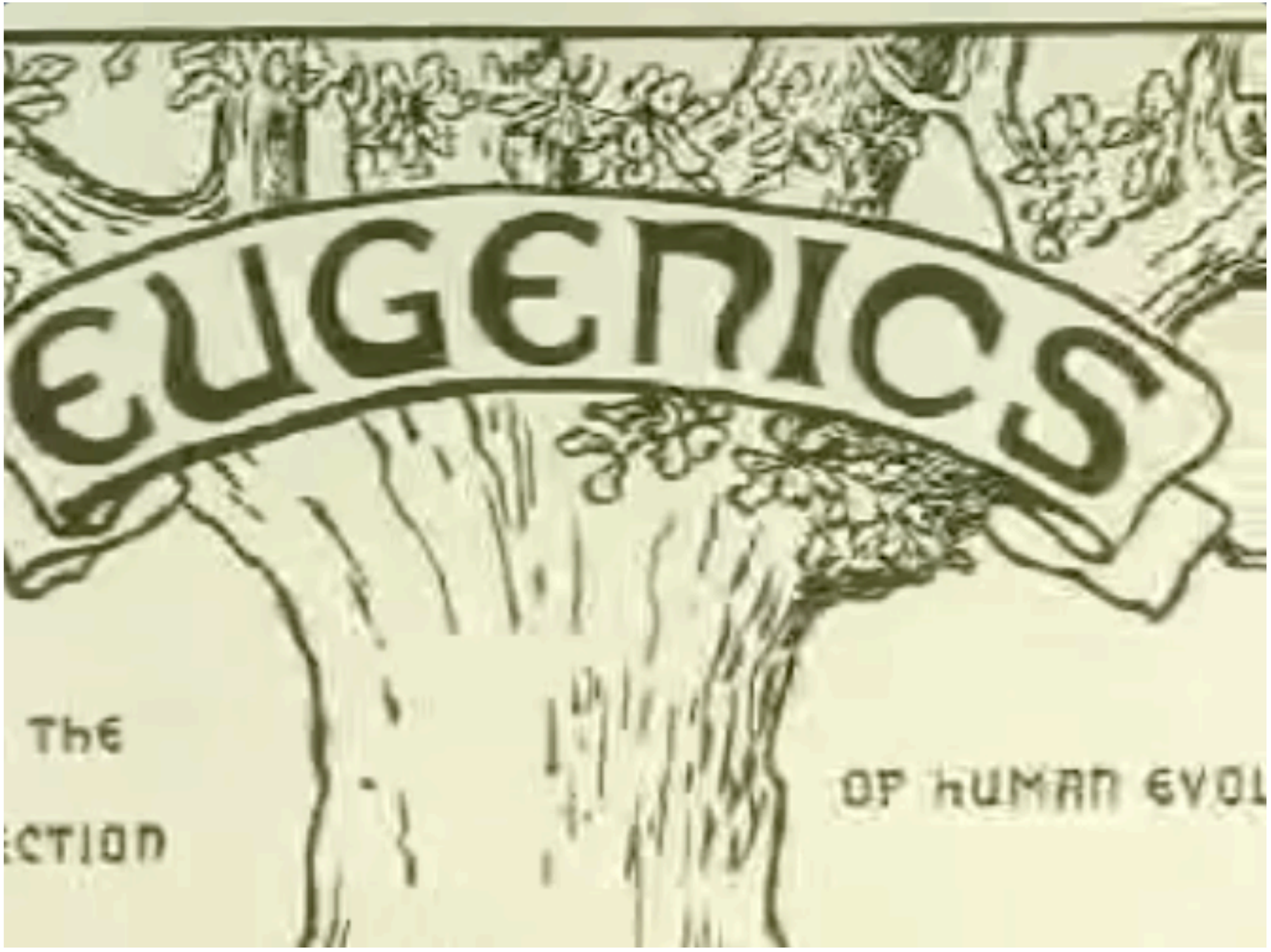
# Shotgun Debate
# Engineering babies PRO vs NO


EUGENICS
The
OF HUMAN EVOL

Questions?