

# **OLLI SG 497**

# **Ancient DNA**

**Session 1 - September 21, 2022**

# Today's Meeting

- Introductions
- My Background and Approach
- Review of Operational Procedures
- Review of the Syllabus
- Recommended Resources
- About the Author and About the Book
- General Observations on Ancient DNA
- The Science of Ancient DNA (Part 1)

# Introductions

- Knowledge of Biology? High School, College, Work?
- Knowledge of Genetics? Knowledge of Statistics?
- Any Statisticians, Geneticists, etc.?
- Did you know about Ancient DNA before signing up for this study group?  
And if you did, were you more interested in the science of Ancient DNA or the findings?
- And if you are new to the subject... Your Interest in Taking This Study Group?

# My Background

- BA, Philosophy, 1972, Temple University, Philadelphia
- Teaching Fellowship in Philosophy, Graduate School, Temple Univ. (4 years)
- Career in Information Technology (Mostly Federal Govt.)
- First OLLI Study Group - Fall 2015
- Led 17 Unique Study Groups - 9 Biology, 3 Geology, 5 Philosophy
- With Repeats, Led 23 Study Groups

# My Approach

- Not a Teacher, Not a Lecturer, Just a Study Group Leader
- Encourage Optimum Participation
- Mix of Presentation, Discussion, Comments, Q&A
- Maintain a Casual Atmosphere - but focused on the subject.

# Operational Procedures

- I will prepare and email to you a summary of the assigned reading in advance of the meeting.
- I will email a PDF of the slides used in each meeting right after the meeting.
- Caveat: If the email file exceeds a certain size, I will only make it available on OLLI's website. My email provider rejects very large emails.
- I will also post all material used in this study group on OLLI's website.
- If needed, and if there is sufficient interest, I will set up and host Zoom meetings for questions and additional presentations.

## Syllabus - Fall 2022

# Syllabus

The book: *Who We Are, and How We Got Here: Ancient DNA and the New Science of the Human Past* by David Reich

- Session 1: Sep. 21 - Introductions and Operating Procedures; comments on the book  
- The science of Ancient DNA (Part 1)  
- Read: Introduction
- Session 2: Sep. 28 - The science of Ancient DNA (Part 2)  
- Read: Chapter 1 - How the Genome Explains Who We Are
- Session 3: Oct. 5 - Neanderthals and Modern Humans  
- Read: Chapter 2 - Encounters With Neanderthals
- Session 4: Oct.12 - Denisovans, Modern Humans and Ghost Populations  
- Read: Chapter 3 - Ancient DNA Opens the Floodgates  
- Read: Chapter 4 - Humanity's Ghosts
- Session 5: Oct. 19 - Population Mixtures and Population Replacement; the Yamnaya  
- Read: Chapter 5 - The Making of Modern Europe
- Session 6: Oct. 26 - Ancestral North Indians and Ancestral South Indians  
- The Yamnaya and Origin of Indo-European Languages  
- Read: Chapter 6 - The Collision That Formed India
- Session 7: Nov. 2 - Populating the Americas - Out of Asia  
- The Origin of East Asians and Their Migrations  
- Read: Chapter 7 - In Search of Native American Ancestors  
- Read: Chapter 8 - The Genomic Origins of East Asians
- Session 8: Nov. 9 - African Migrations and Population Mixtures  
- Read: Chapter 9 - Rejoining Africa to the Human Story
- Session 9: Nov. 16 - Consequences of Ancient DNA - Uses and (Potential) Abuses (Part 1)  
- Read: Chapter 10 - The Genomics of Inequality  
- Read: Chapter 11 - The Genomics of Race and Identity
- (No class on Nov. 23 - OLLI closed for Thanksgiving)
- Session 10: Nov. 30 - Consequences of Ancient DNA - Uses and (Potential) Abuses (Part 2)  
- Summation and Observations  
- Read: Chapter 12 - The Future of Ancient DNA

# Recommended Resources



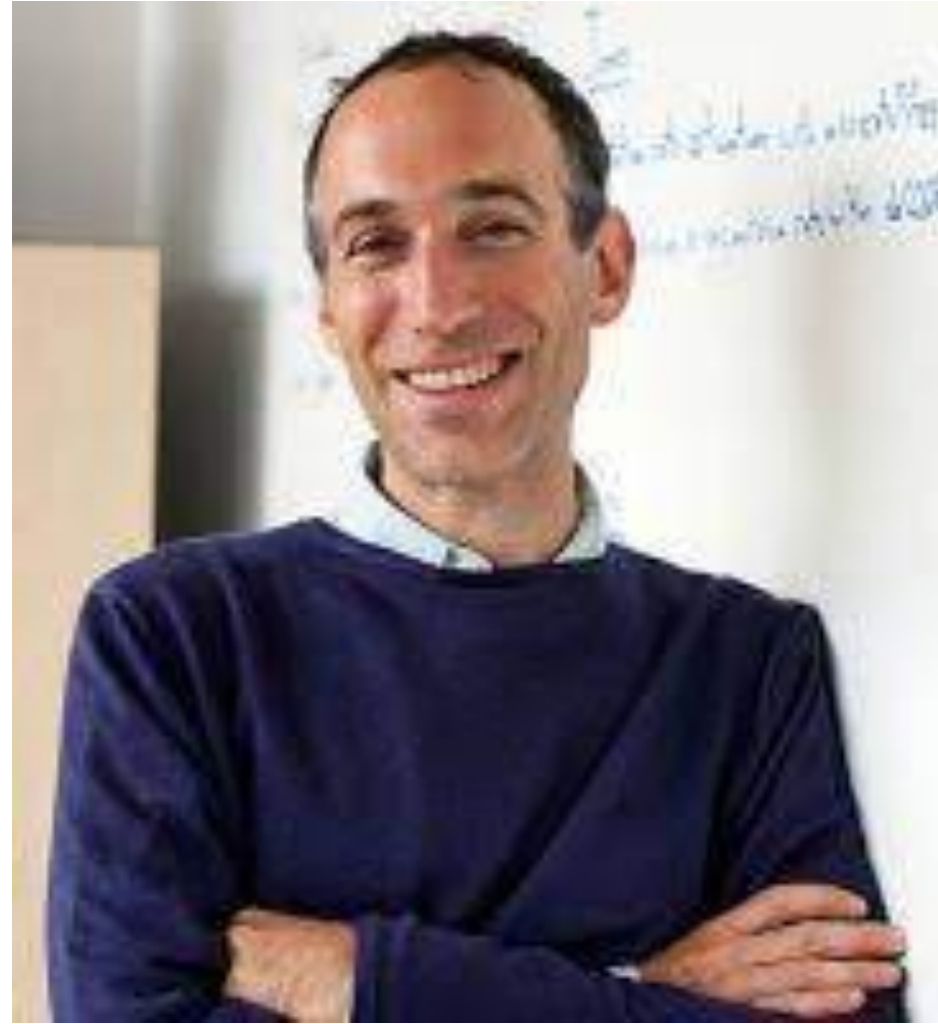
- Who We Are and How We Got Here: Ancient DNA and the New Science of the Human Past - David Reich, Pantheon Books, 2018

## David Reich Lectures

- [Simons Foundation Lecture](#)
- [Shorter Version](#) (HHMI)
- [Harvard Lecture](#)



# David Reich



- Born: July 1974
- Professor of Genetics, Harvard Medical School
- Professor of Human Evolutionary Biology, Harvard Univ.
- BA Physics, Harvard. PhD Zoology, Oxford Univ.
- Investigator, Howard Hughes Medical Institute (HHMI)
- Associate of the Broad Institute
- Born and raised in Washington, D.C. Father was first director of the Holocaust Museum.

# About the Book

## Odds and Ends

- Use of grey-scale graphics not helpful.
- Published in 2018, but findings and technique are so important and interesting that it's worth reading even if new findings and techniques overtake them.
- Well written, and written for the lay person interested in the findings; but very opaque on aspects of the technology. More detail would have been helpful.
- Use of the phrase “after x years ago”. Two things to keep in mind:
  - “After 5000 years ago” is about 3000 B.C.E. (give or take 22 years).
  - And 3000 B.C.E. sets the outer (earliest) limit for when an event occurred.

# Science of Ancient DNA

## Topics

- DNA, Genes, and Recombination (Meiosis).
- Ancient DNA is an example of statistical genetics.
  - Similar in scope to Genome-Wide Association Studies (GWAS).
  - Looks for density of variances in certain areas of the genome. Looks for single nucleotide polymorphisms (SNP) between genomes.
  - Principal Component Analysis is at the core of the methodology.
- Methods for extracting, purifying and sequencing ancient DNA.

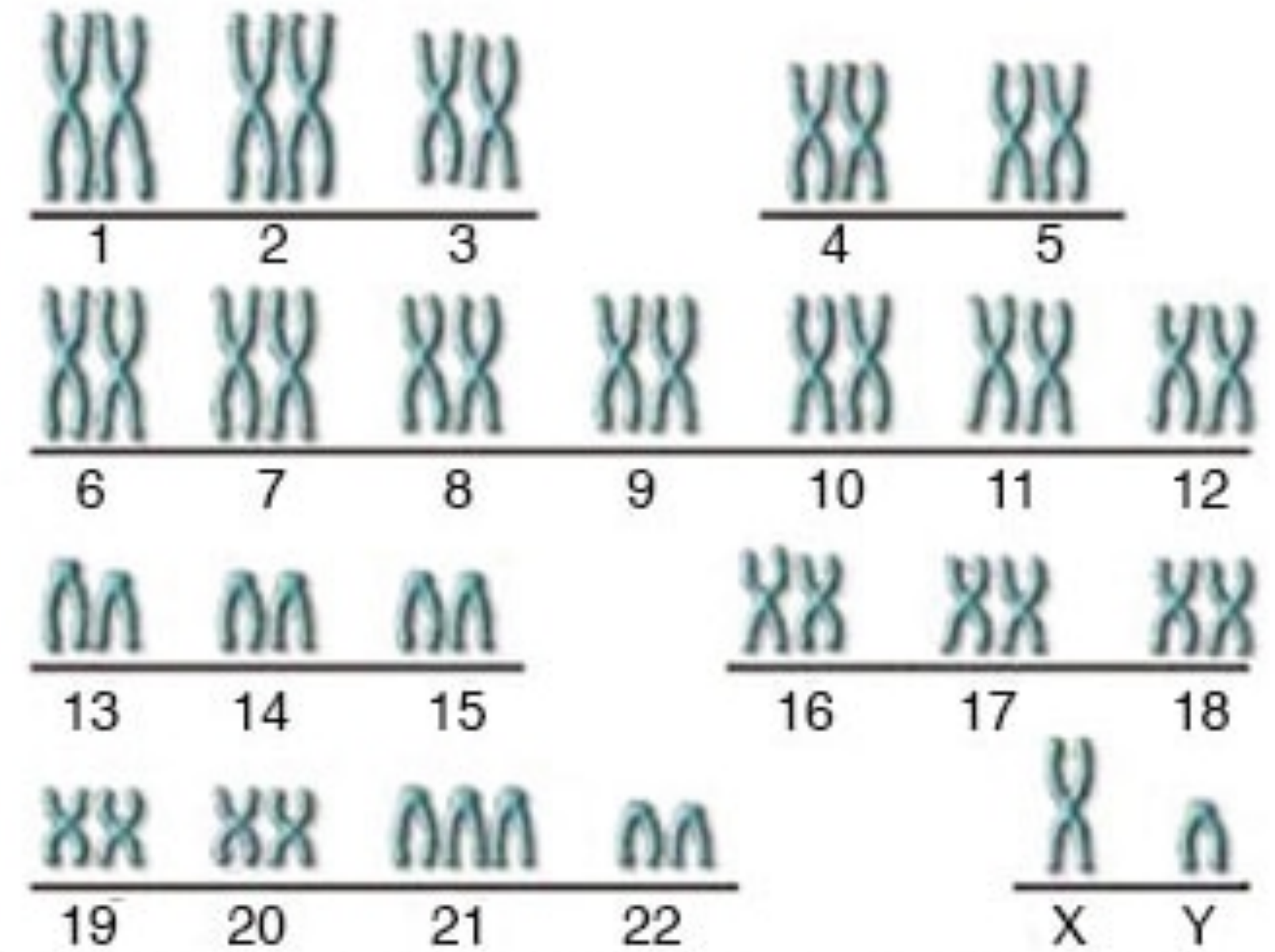
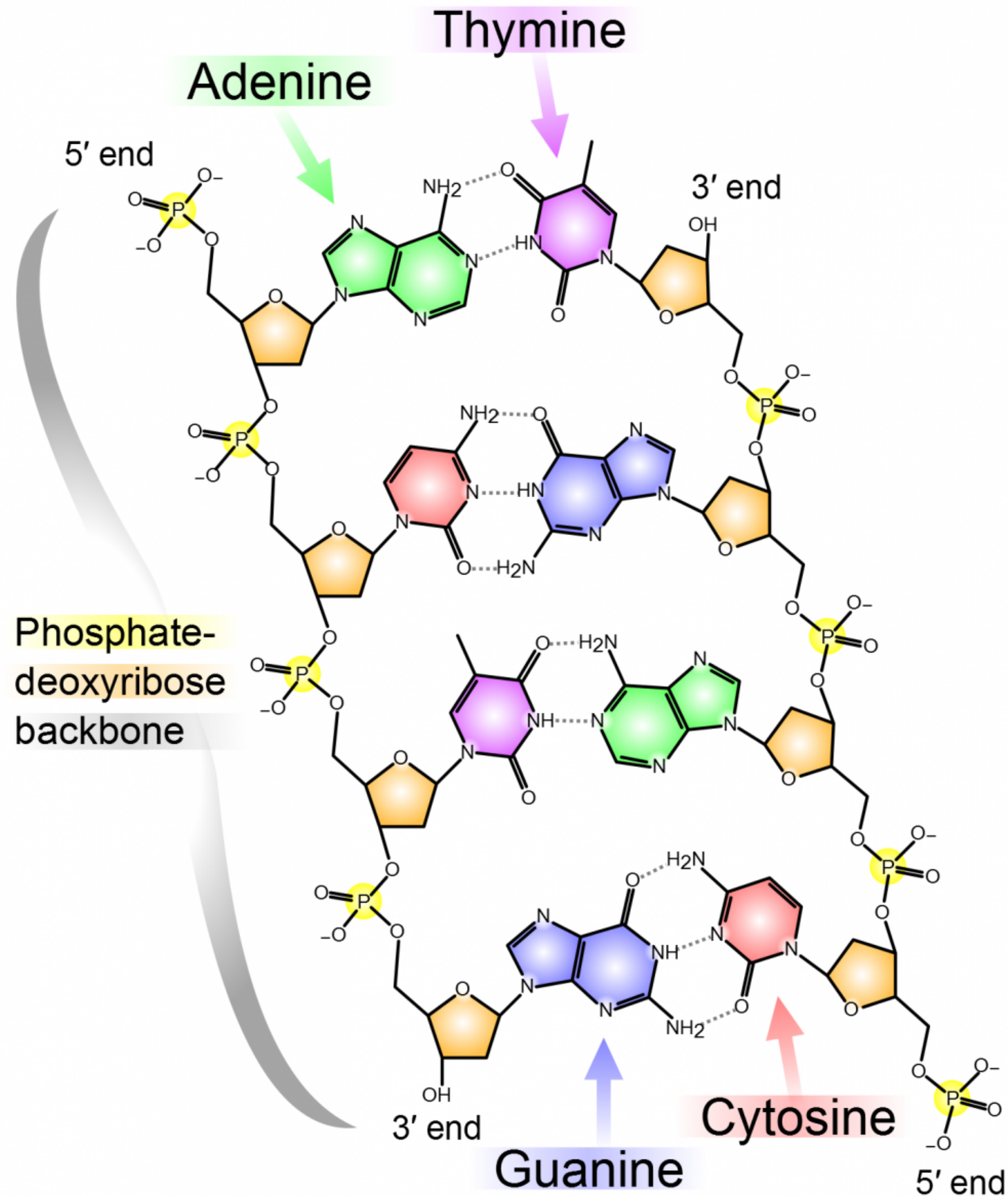
# Science of Ancient DNA

## Unanswered Questions

- Mutations in DNA extracted from somatic cells versus mutations in germline cells.
  - Are we looking at mutations in individuals which are not passed on to offspring?
- Rate of accumulation of mutations.
  - The larger the density of variants between genomes the greater the time difference between them.
  - Mutations occur at a known(?) rate during cell division.
  - How accurate is Reich's rate of accumulation?

# DNA

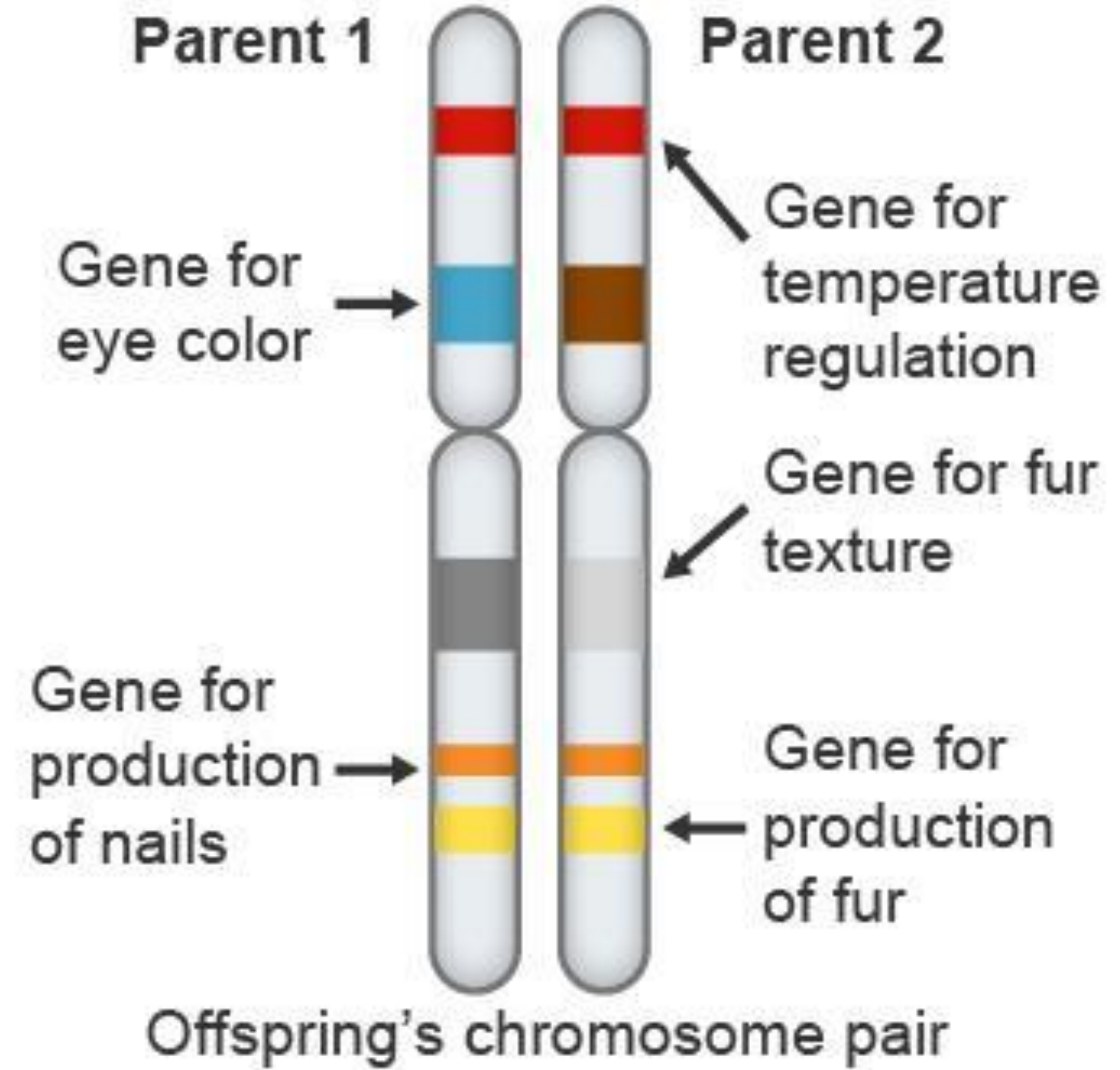
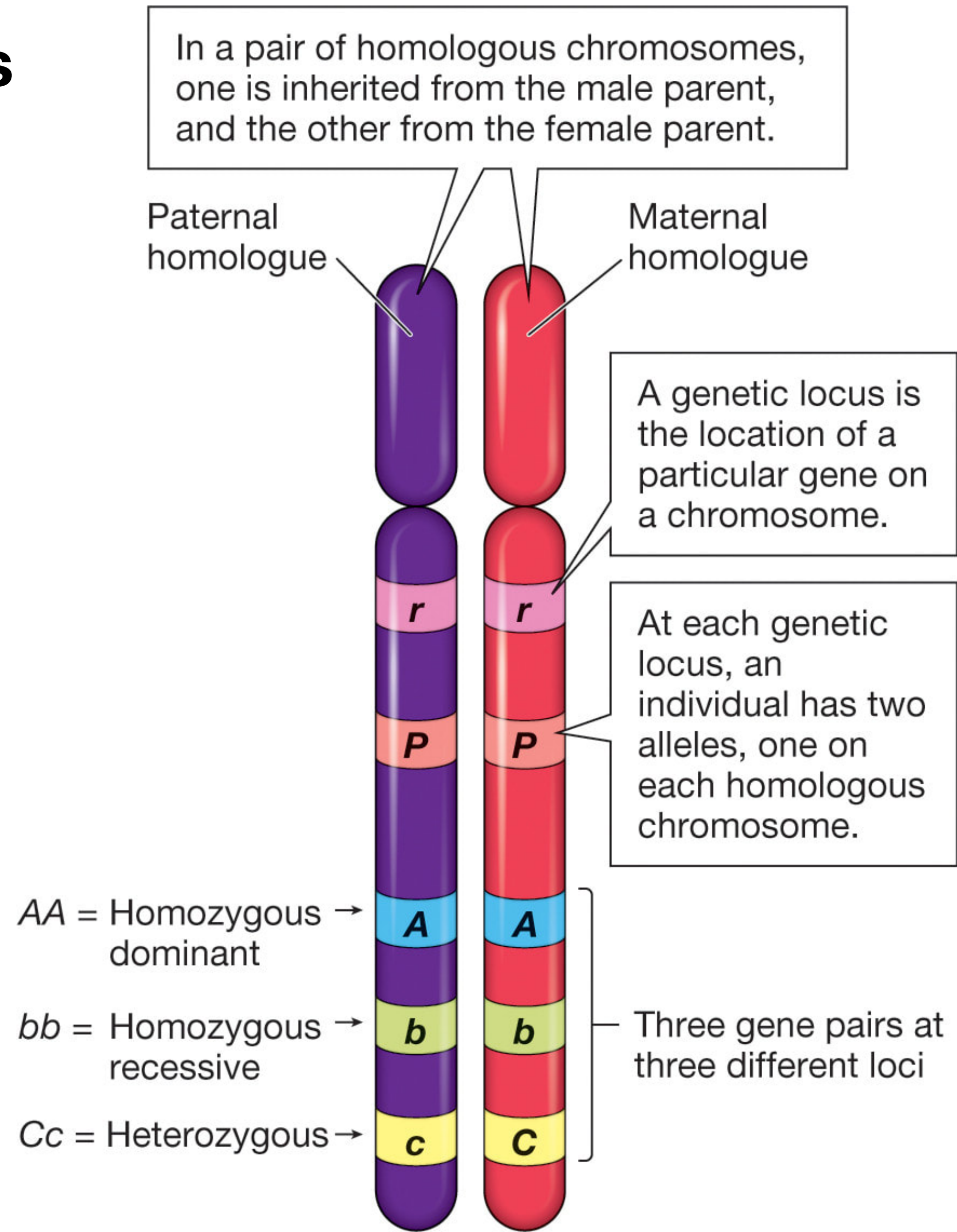
Chromosomes



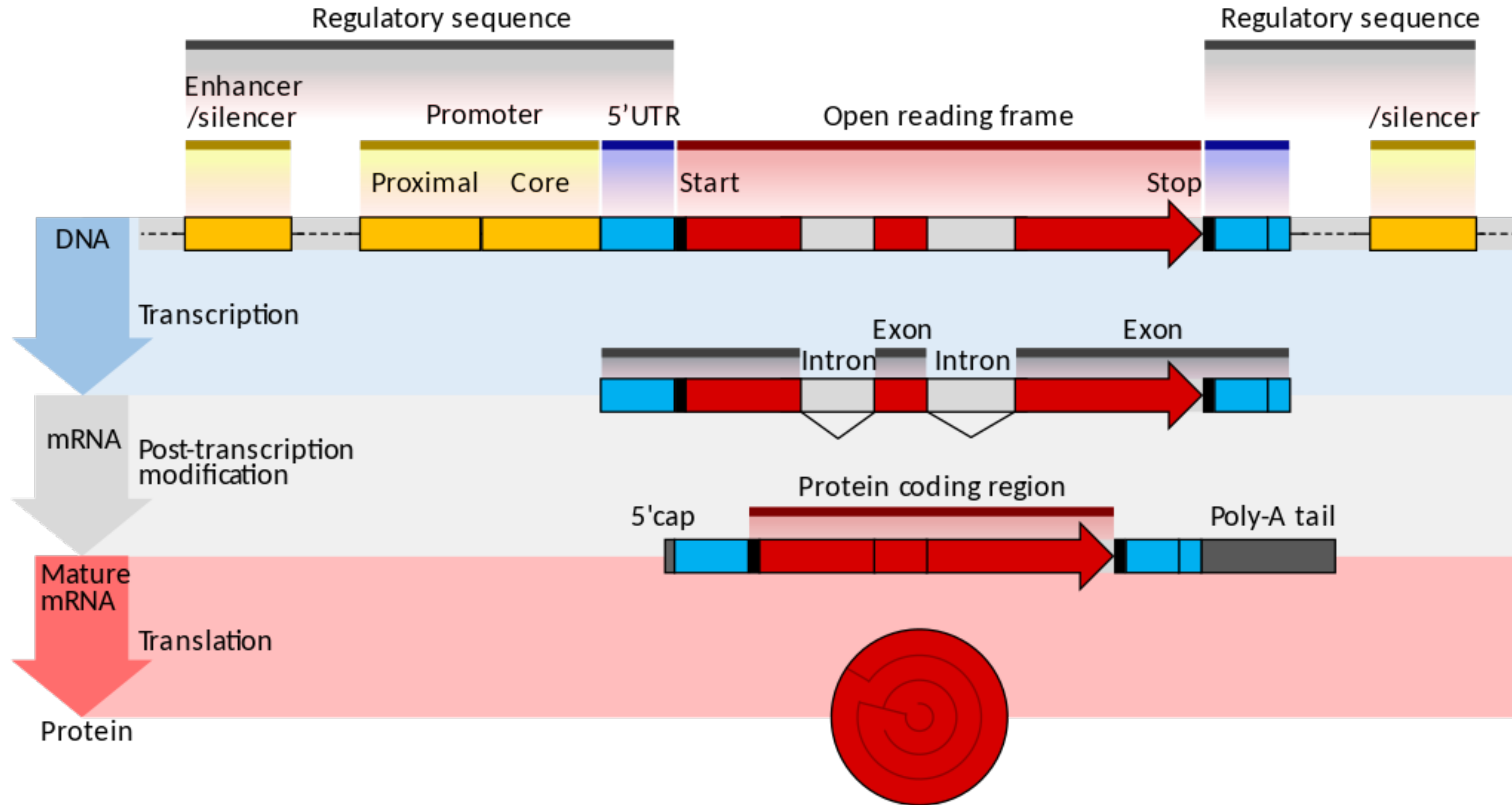
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# Chromosomes

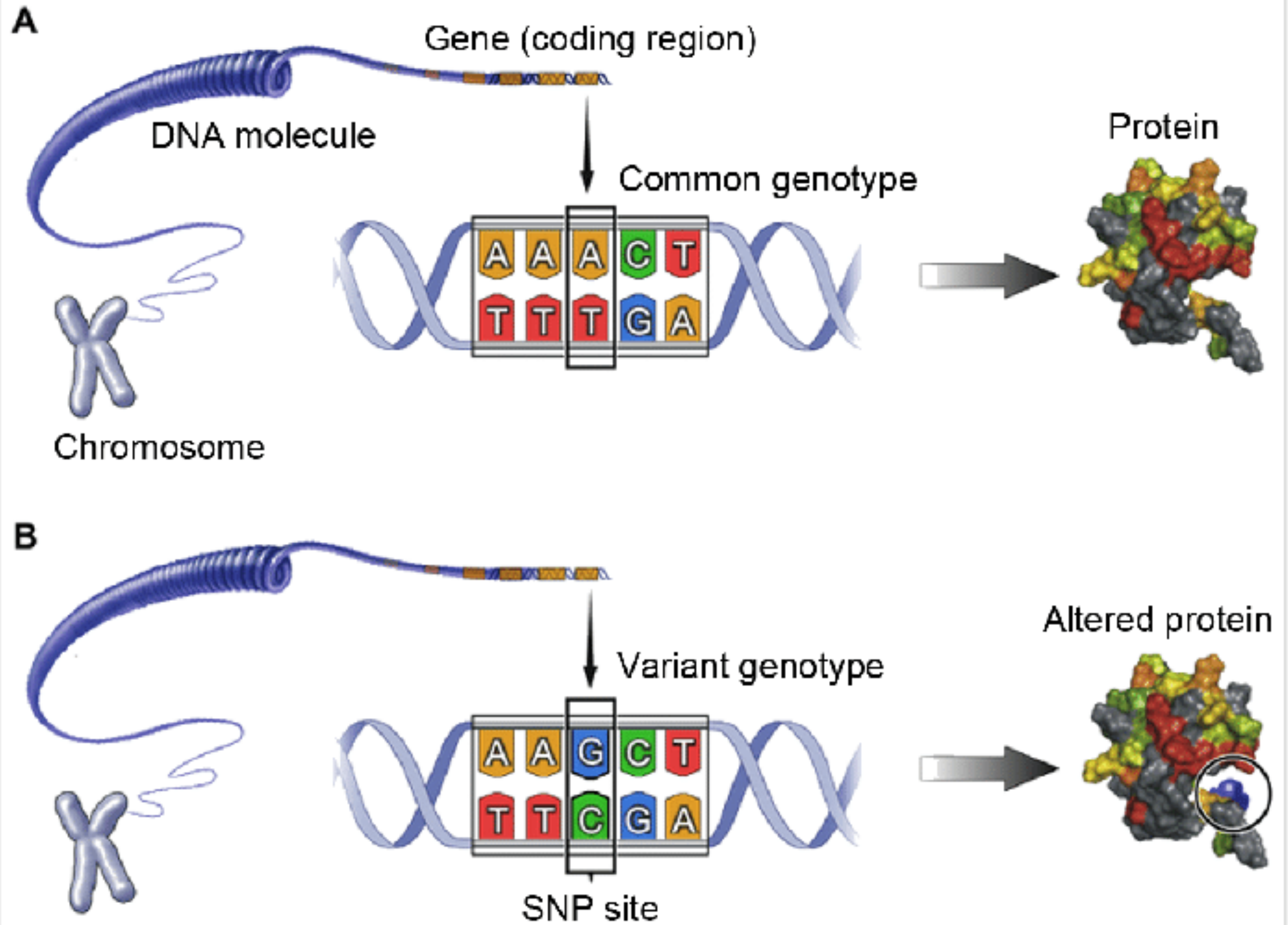
# Alleles



# Genes



# Single Nucleotide Polymorphism





# Meiosis and Recombination

- During cell division of germline cells (eggs and sperm), random shuffling of the DNA contributed by both parents occurs.
- Chromosomes swap segments (crossing over or recombination), and independently align.
- This results in multiple, unique gametes with 23 chromosomes (actually, for eggs it is somewhat more complicated than this, but the net result is the contribution of 23 chromosomes to the zygote).
- Meiosis.

# Up Next

- Science of Ancient DNA (Part 2)
  - More on statistical genetics, and the hunt for variances in nucleotide sequences.
  - Principal Component Analysis.
  - Laboratory method for extracting, purifying, and analyzing ancient DNA.
- Meyer and Fu's methodology, and Reich and Rohland's enhancements.
- Chapter 1: How the Genome Explains Who We Are.