

Theme #1
"Big Tree"
of Life



Genomic DNA

- 1) Classification of Genomic DNA
- 2) Complexity of Genomic DNA

Genomic DNA Classification

- Protein coding genes**
 - Solitary
 - Duplicated/Diverged
- Tandemly repeated genes**
 - rRNA, tRNA, histones
- Repetitive DNA**
 - Simple sequence
 - Moderately repeated
 - Mobile elements
- Spacer DNA**

See **Table 10-1** for a terrific breakdown on the
Major Classes of Eukaryotic DNA

C-Value Paradox

C-Value = amount of haploid DNA

Nematode	0.097 (x10 ⁹)	↓
Fruit Fly	0.18	
Sea Urchin	0.87	
Chicken	1.13	
Zebrafish	1.64	
Mouse	3.01	
Human	3.19	
Octopus	4.56	
Grasshopper	13.4	
Salamander	38.3	
Lungfish	140	

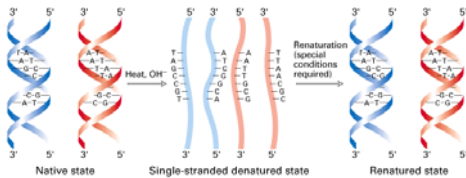
Paradox: Not consistent with "complexity"
or phylogeny

Complexity of Genomic DNA

The complexity of a DNA sequence is the amount of DNA, counted in bp, such that all sequence is represented only once.

Sequence	Complexity
AAAAAAA	1
<u>A</u> T <u>C</u> G <u>A</u> A <u>T</u> C <u>G</u> A <u>A</u> T <u>C</u> G <u>A</u>	5
<i>E. coli</i> genome	4 X 10 ⁶
Human	~50% of the Genome Unique

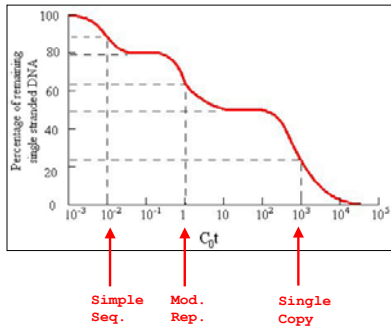
Renaturation of DNA



Highly repetitive sequence renatures **quickly**
Single copy sequence renatures **slowly**

Does this make sense? WHY?

C₀t Curve



<http://www.ucl.ac.uk/~ucbhjow/b241/genome.html>

Theme #2

Inference vs. Observation

Inference: Deduction, to draw a conclusion from prior knowledge and evidence.

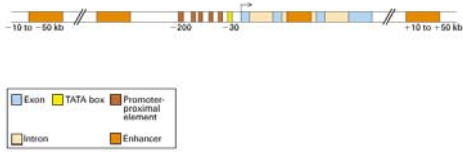
Most experimental science relies on inference rather than observation

(Exam questions will require inference.)

There are Three Major Fractions of Eukaryotic DNA

- 1) **Single Copy sequence** (50-60% in mammals)
~5% mammalian Genome is coding region
Remainder is introns, regulatory regions and spacer DNA
- 2) **Simple-sequence** (10-15% in mammals)
"Satellite DNA"
- 3) **Moderately repeated** (25-40% in mammals)
Small percentage of gene families and tandemly repeated genes
Mobile elements

Single Copy DNA



50-60% of genome is Single Copy sequence
 ~5% genome is coding region
 Remainder is introns, cis-regulatory regions and spacer DNA

Genome Sequences

	Estimated genes
<i>C. elegans</i>	20,000
<i>D. melanogaster</i>	15,000
<i>H. sapiens</i>	40,000

Apparently little relationship between "complexity" and number of genes.

Eucaryotic Gene Structure

(a) Simple transcription unit

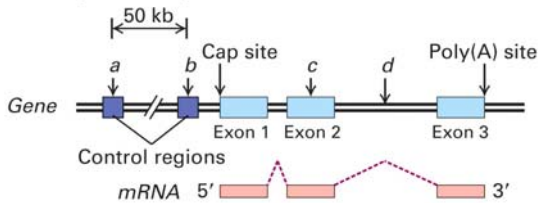


Fig 10-2

Satellite DNA

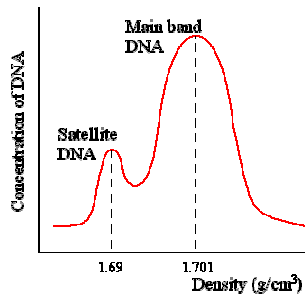
Short (< 100 bp) repeats in tandem arrays

Millions of bp in length

Example: Centromeric DNA from Humans contains a 171 bp AT-rich repeat called alpha-satellite DNA

Purpose: Some satellite DNA appears to contribute to kinetochore structure

Density Gradient: Satellite DNA



Simple Sequence FISH

Fluorescent
In
Situ
Hybridization

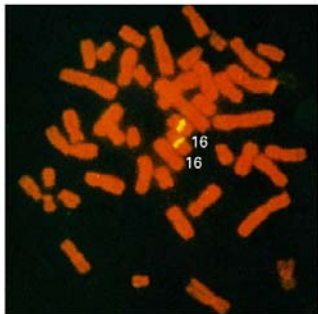
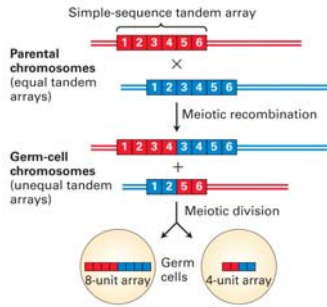


Fig 10-5

Unequal Recombination: microsatellite variation



Potential
Exam
Question

Fig 10-6

DNA Fingerprinting

Polymorphisms in simple sequence repeats distinguish individuals.

3 minisatellite "probes"

Experiment:

- (1) Cut of DNA into bits
- (2) Probe with minisat DNA

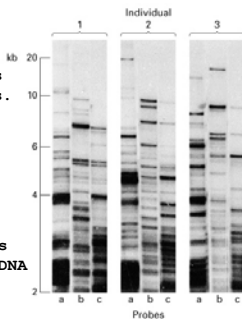
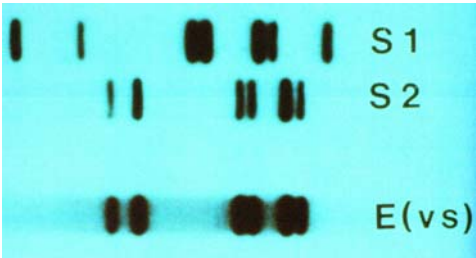


Fig 10-7

DNA Fingerprinting: Utility

- Solving Crimes: Used in 70,000 cases
- Paternity Testing: 130,000 paternity tests/year in US
- Identifying Victims of Sept. 11th
- Hundreds of scientific studies - Animal behavior, population genetics

Criminal Case: DNA Fingerprinting



S = Suspect E = Evidence

Evolution = Freedom

The San Diego Union Tribune | NATION | Sunday, August 26, 2001

Inmate free; DNA clears him in three 1985 rapes

ASSOCIATED PRESS

ST. LOUIS — A man who served 27 years in prison for three rapes was freed yesterday after DNA tests proved he didn't do it.

Circuit Judge Dennis Edwards acquitted Lennie Erby for the wrongful conviction, noting the science of criminal investigation "has improved since 1985."

Erby said of the verdict: "That was the one thing I was waiting for."

Erby, 46, was sentenced to 15 years for the 1985 attacks on three girls. He was released after genetic testing found the semen taken from the victims wasn't his.

Immediately after being freed, Erby hugged the men he had seen just once since his incarceration.

Erby was the second inmate convicted of a St. Louis rape to be freed after DNA testing sought by the Innocence Project, headed by Barry Schick, who gained fame as part of the O.J. Simpson defense team.

In July 2002, Larry Johnson was released after spending 14 years in prison for the 1984 rape of a Saint Louis University student.

Nationally, more than 300 men and women have been freed from prison as the result of DNA testing, the Innocence Project said.

Erby has confirmed the truth of some other convictions.

Romanov Family



Moderately Repeated DNA

Gene Families

e.g., Kinases
Transcription Factors

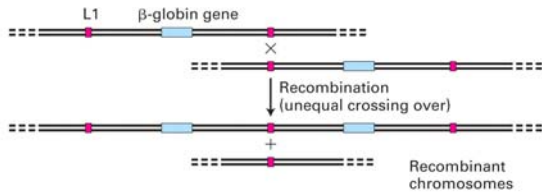
Tandemly repeated genes

rRNA
tRNA
Histones

Mobile Elements

"Selfish DNA"
Transposons

Gene Duplication from Unequal Crossing Over



L1 = Line 1 Mobile Element

Fig 10-4

Tubulin Duplication and Divergence

Why are these duplicates maintained?

Any potential advantages?

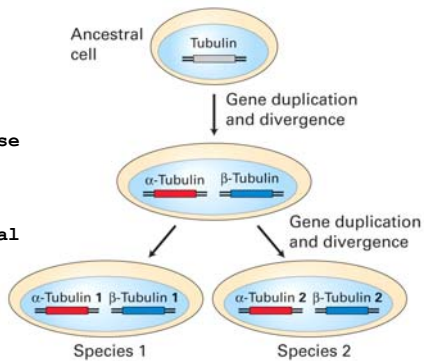
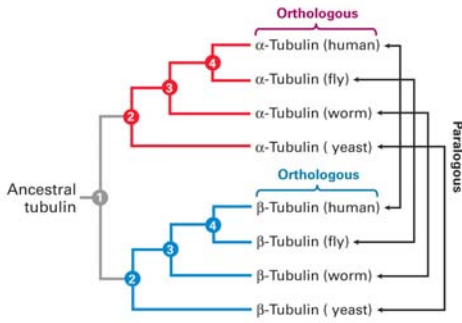


Fig 9-32

Ortholog & Paralogs



Importance: Gene identity used to infer function

Fig 9-32
