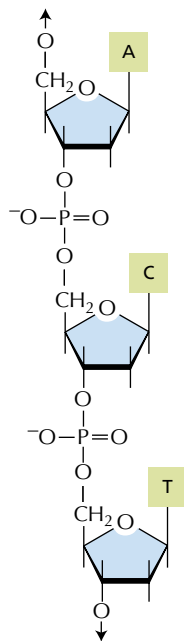


Thinking questions

1. DNA isolated from the bacterial virus M13 contains 25% A, 33% T, 22% C, and 20% G. Do these results strike you as peculiar? Why or why not? How might you explain these values?

M13 virus contains single-stranded DNA as a genome.

2. A segment of DNA is shown in the figure below. What is the polarity (5'-3' or the opposite) of this DNA from top to bottom?



The above part is 5' and bottom is 3' (check the sugar ring).

3. Human DNA contains 20% C on a molar basis. What are the mole percents of A, G, and T?

Then G is 20%, A and T are each 30%.

4. What is a "gene."

There are multiple definitions but the bottomline is the following: A gene is a DNA sequence localized on the genome that leads to the expression of proteins or a final RNA product.

5. Histone proteins are among the most highly conserved proteins in eukaryotes. Histone H4 proteins from a pea and a cow, for example, differ in only 2 out of 102 amino acids. However, comparison of the two gene sequences shows many more differences. These observations indicate that mutations that change amino acids must be selected against. Why do you

suppose that most amino acid-altering mutations in histone genes are deleterious?

Histones are highly conserved as they have the same role in all cells and the DNA they bind to is the same.

Link each term to its definition (not all terms have a definition)

cell cycle – centromere- chromatin- chromosome- exon- intron – karyotype- nucleosome- replication- origin- telomere – histone- histone H1- homologous chromosome

- Full set of chromosomes of a cell arranged with respect to size, shape, and number. (Karyotype)
- Constricted region of a mitotic chromosome that holds sister chromatids together. (Centromere)
- Any one of a group of small abundant proteins, rich in arginine and lysine, that form the primary level of chromatin organization. (Histone)
- Structure composed of a very long DNA molecule and associated proteins that carries part (or all) of the hereditary information of an organism. (Chromosome)
- The orderly sequence of events by which a cell duplicates its contents and divides into two. (Cell cycle)
- Complex of DNA, histones, and non-histone proteins found in the nucleus of a eukaryotic cell. (Chromatin)
- One of the two copies of a particular chromosome in a diploid cell, each copy being derived from a different parent. (Homologous chromosome)
- Beadlike structure in eukaryotic chromatin, composed of a short length of DNA wrapped around a core of histone proteins. (Nucleosome)

Multiple choice questions

- 1) You want to detect a specific histone modification across the genome and identify all the sequences of DNA that are bound to the modified histones. Which method will you use?
 - a) FISH?
 - b) ChiP?
 - c) building a karyotype
 - d) None of the above

The correct answer is B. Chromatin-immune precipitation allows to determine histone modifications and their location in the genome.

- 2) Chromosome occupy specific territories in the nucleus. How can this be visualized?

- a) FISH?
- b) ChiP?
- c) building a karyotype
- d) None of the above

The correct answer is A. Fluorescent In Situ Hybridization detects specific regions of DNA in the nucleus.

- 3) Viruses
 - a) Have a high number of genes
 - b) Have long intergenic regions
 - c) Have 1.5% of their DNA encoding proteins
 - d) Have most of their DNA encoding proteins?

The correct answer is D. Viruses have a short genome with most parts involved in protein coding.

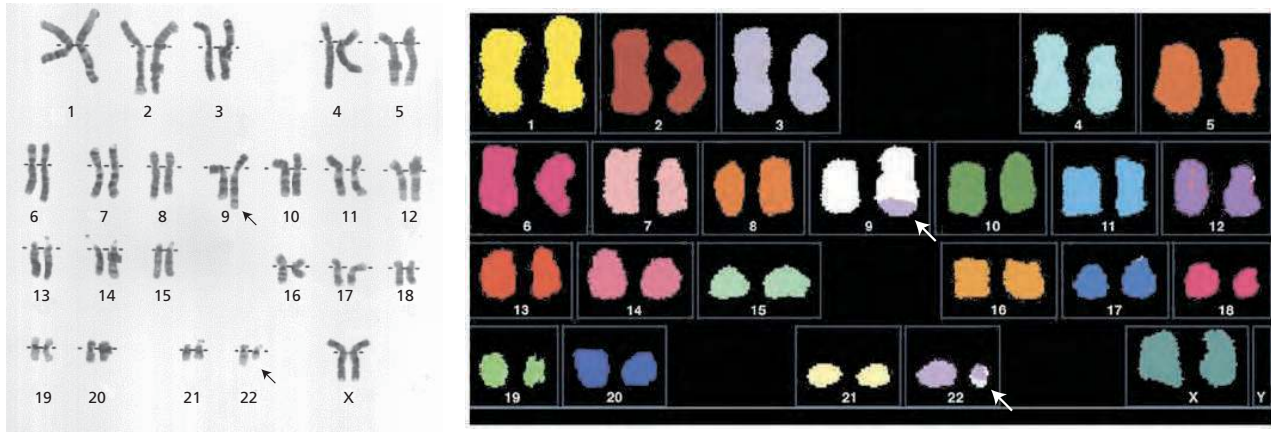
- 4) By comparing genomes, scientist can identify
 - a) Epigenetic marks
 - b) Histone modifications
 - c) Functional DNA sequences
 - d) Heterochromatin

The correct answer is C.

- 5) When a SNP is non-synonymous, it means that
 - a) Two nucleotides are modified at a given position in the genome
 - b) This given mutation is associated with a disease
 - c) The SNP is located in a non-coding DNA region
 - d) The SNP is located in a coding region and leads to a change of amino acid

The correct answer is D.

- 6) An abnormal human karyotype is shown below. This particular karyotype is found in the cancer cells of more than 90% of patients with chronic myelogenous leukemia. Arrows indicate two abnormal chromosomes. What statements are correct?



- a) This patient is a male
- b) This patient is a female
- c) This patient had a deletion of a fragment of chromosome 12
- d) This patient had a balanced translocation between chromosome 9 and 22
- e) This patient had an unbalanced translocation between chromosome 9 and 22

The correct answer is B and D.

TRUE or FALSE

- 1) Two homologous genes have always redundant functions in the genome.

TRUE or **FALSE**

Homologous are genes with similar functions derived from a common ancestor.

- 2) Is the genome defined as the totality of the genetic information carried in the DNA of a cell or an organism?

TRUE or FALSE

The genome is composed by coding, non-coding sequence, and repetitive elements and these represent the entire genetic information contained in a cell.

- 3) Human cells contain a long DNA molecule in which only 1.5% encodes for proteins.

TRUE or **FALSE**

The human genome consists of chromosomes and not a single molecule.

4) SNP are long blocks of DNA sequence that differs in the number of times they are present in the genomes of different individuals in a population.

TRUE or **FALSE**

SNPs correspond to single nucleotide variation

5) Gene duplication and divergence is thought to have played a critical role in the evolution of increased biological complexity

TRUE or FALSE

Duplication of chromosomal segments, which may include one or more genes, allows one of the two genes to diverge over time to acquire different, but related functions. The process of gene duplication and divergence is thought to have played a major role in the evolution of biological complexity.

6) In a comparison between the DNAs of related organisms such as humans and mice, identifying the conserved DNA sequences facilitates the search for functionally important regions.

TRUE or FALSE