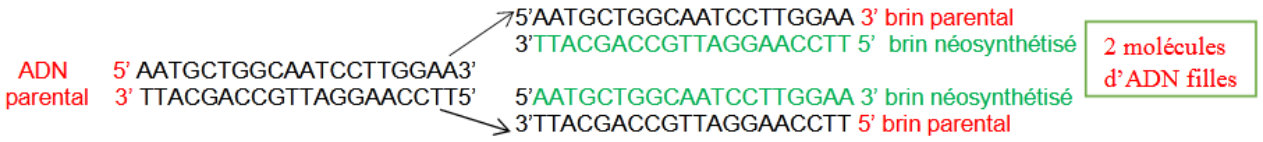
TD 2 (DNA Replication and Transmission of Characteristics)

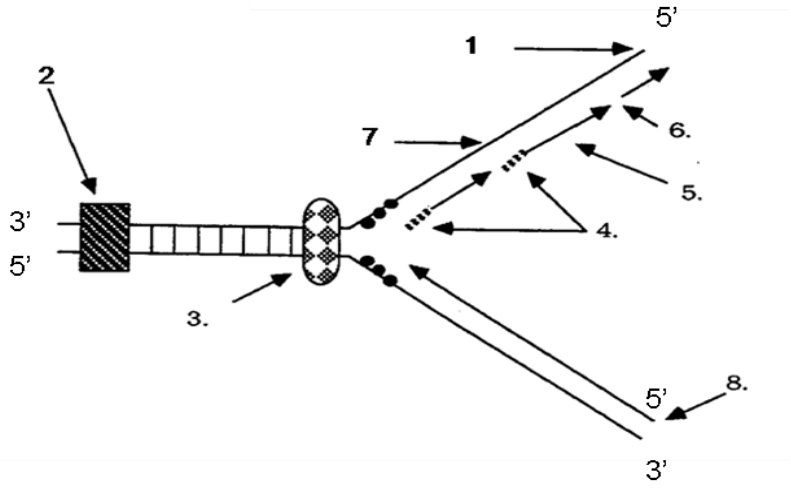
Exercise 1

To duplicate DNA, the 2 strands are separated and an enzyme comes to place the appropriate base in front of each base. Write the daughter molecules obtained by duplicating the following portion of DNA:



To duplicate DNA, the 2 strands are separated and an enzyme puts the appropriate base in front of each base. The daughter molecules obtained by duplicating the portion of DNA are written by observing the base pairing rule. First, each strand must be given a polarity (one is read in the 5' – 3' direction and the other is antiparallel and is therefore read in the 3' – 5' direction). Each duplicated strand is complementary and antiparallel to the parent strand.

Exercise 2



A. Which end (5' or 3') of the molecule is indicated by arrow number 1?

5' (SEE CORRECTED FIGURE)

B. Which end (5' or 3') of the molecule is indicated by arrow number 8?

5' (start of the neo -synthesized strand)

C. What type of nucleic acid is indicated by arrow number 4? What enzyme synthesizes it?

RNA (primer)

Synthesized by primase and would be degraded afterwards and replaced by DNA by DNA Polymerase I

D. What are the short fragments of DNA indicated by arrow number 5?

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Okasaki fragments synthesized by DNA Polymerase III

E. What enzymatic function to join the short fragments indicated by arrow number 6?
DNA ligase

F. Which enzymes are indicated by arrows number 2, 3? What is their role?
Arrows 2: Topoisomerase : removes the superturns of the double helix generated by the opening of the DNA
Arrows 3: DnaA + Helicase (DnaB) opening of the two DNA strands and breaking of hydrogen bonds between the bases

G. What is the name of the strand indicated by arrow number 7?
Strand delayed.

E. Explain why the main strand (direct or leading strand) strand) is replicated much faster than the lagging strand strand).
The leading strand is synthesized continuously from a primer while the lagging strand is synthesized from many smaller fragments (Okasaki fragment). This requires DNA polymerases to attach to the lagging strand repeatedly, which limits the rate of polymerization. On the other hand, each Okasaki fragment needs to have the RNA primer replaced by DNA and phosphodiester bonds must be formed between each fragment by a DNA ligase.

Exercise 3

Answer true or false to the following statements:

Mitosis

1- Interphase and mitosis together constitute the cell cycle..... TRUE
2- Mitosis allows the separation of homologous chromosomes. . . . . FAKE
3- During anaphase, there is a homogeneous distribution of genetic information . . . . . TRUE
4- Only gametes are haploid cells in higher organisms. . . . . TRUE
5- The somatic cells of a diploid organism all have 2n chromosomes . . . . . TRUE
6- The nuclear membrane forms around the newly formed sets of daughter chromosomes during telophase ..... TRUE
7- Duplication of chromatids occurs during prophase ..... FAKE

Meiosis

1- Anaphase I begins with the division of the centromeres of each chromosome . . . . . FAKE
2- At anaphase II, the two sister chromatids of each chromosome separate, resulting in two daughter chromosomes each attached to a daughter centromere. . . . . TRUE
3- Meiosis separates the pairs of chromosomes, fertilization reunites them . . . . . TRUE
4- Chromatid crossing over allows non-sister chromatids to exchange genes. TRUE

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5- In daughter cells resulting from division I of meiosis, the quantity of DNA is diploid . . . . . FAKE

6- Centromeres do not divide during meiosis I. ..... TRUE

7- A cell in prophase I of meiosis has half the number of chromosomes as a cell in prophase II ..... FALSE

8- Crossing-over takes place during the diplotene stage of prophase I, meiosis I ..... FAKE

Exercise 4

In humans, the chromosome number is 2n=46.

- How many chromosomes will be found in the somatic cells of the male? 46
- How many chromosomes will be found in female gametes? 23
- How many chromatids are there at mitotic metaphase? 92
- How many chromosomes does a girl get from her father? 23
- How many autosomes are found in a gamete? 22
- How many sex chromosomes are found in an egg? 1
- How many autosomes are there in a somatic cell in a female? 44

Exercise 5

Fill in the blanks:

- Mitosis occurs still at the level of somatic cells
- Meiosis happens still at the germ cell level
- Mitosis East a equational division
- At mitosis we obtain from of a diploid cell two diploid cells
- Gametes are sex cells
- Production of gametes males East called spermatogenesis
- The nuclear membrane shatters into fragments at the beginning of the ..... PROPHASE
- The equatorial plate of the spindle mitotic East formed during the ..... METAPHASE
- Chromatids separate to form two sets of daughter chromosomes during ANAPHASE
- The period during which DNA East synthesized is called phase S
- The spindle mitotic East made up of microtubules which are polymers of a subunit tubulin protein
- Chromosome migration is made possible by the binding of spindle microtubules to a structure associated with the centromere of each chromosome: the kinetochore
- Cytokinesis is the division of the cytoplasm
- An event meiotic called crossing over product A exchange genetics between chromosomes counterparts
- The complex synaptonemal East formed between homologous chromosomes
- Prophase I of meiosis East subdivided into 5 stages : leptotene – zygotene – pachytene – diplotene and diakinesis
- When the stadium zygotene ends , the pairs of homologous chromosomes are present in the form of bivalents

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- Each tetrad contains two chromatid pairs sisters
- During diakinesis , the chromosomes separate more , but non - sister chromatids still remain attached at the level of the chiasmas

Exercise 3:

Chromosomal nondisjunction during meiosis is the main cause of Down syndrome. Here is a schematic representation of meiosis and gametocyte fertilization.

1) Label the first and second division of meiosis.

2) Complete the diagram in case of accidents in the second division of meiosis leading to trisomy 21 (only represent chromosome 21)