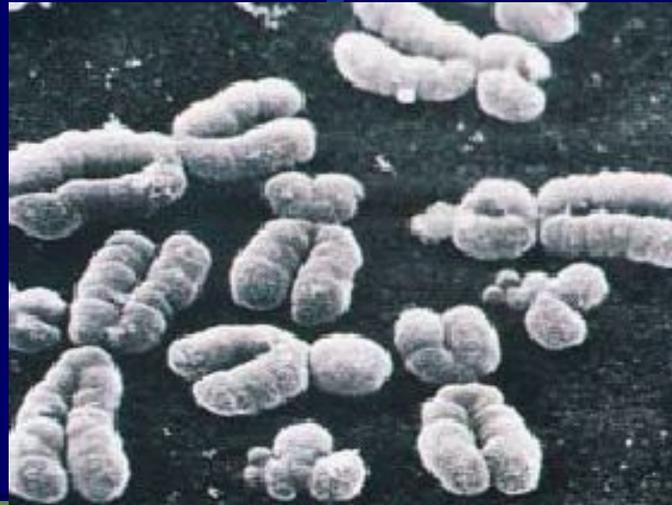
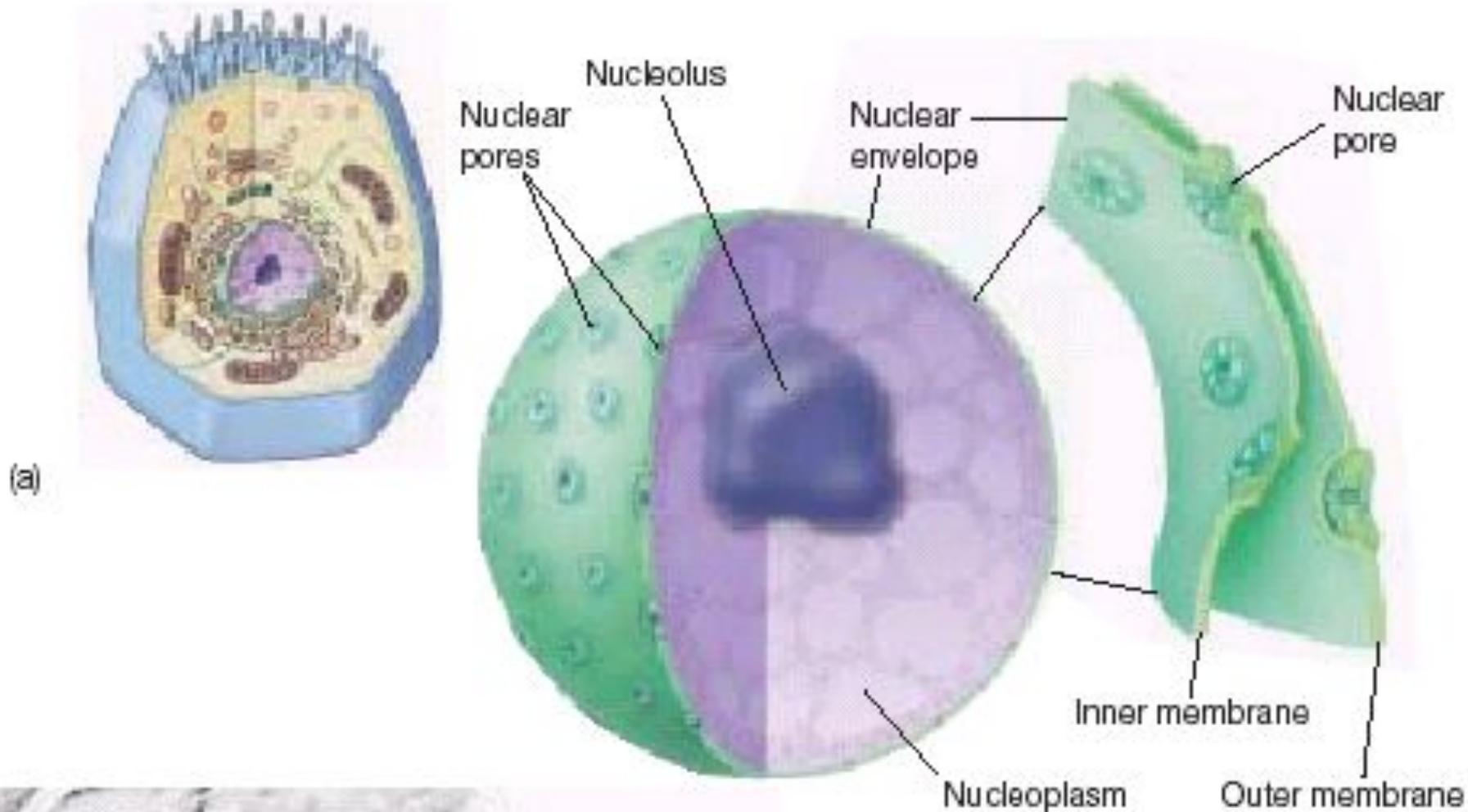


Лекция №2

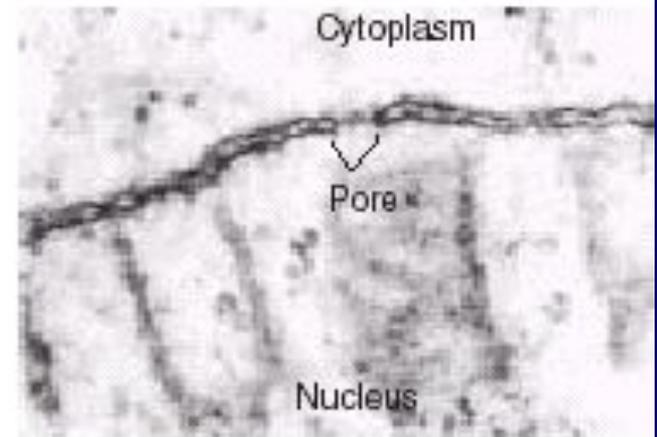
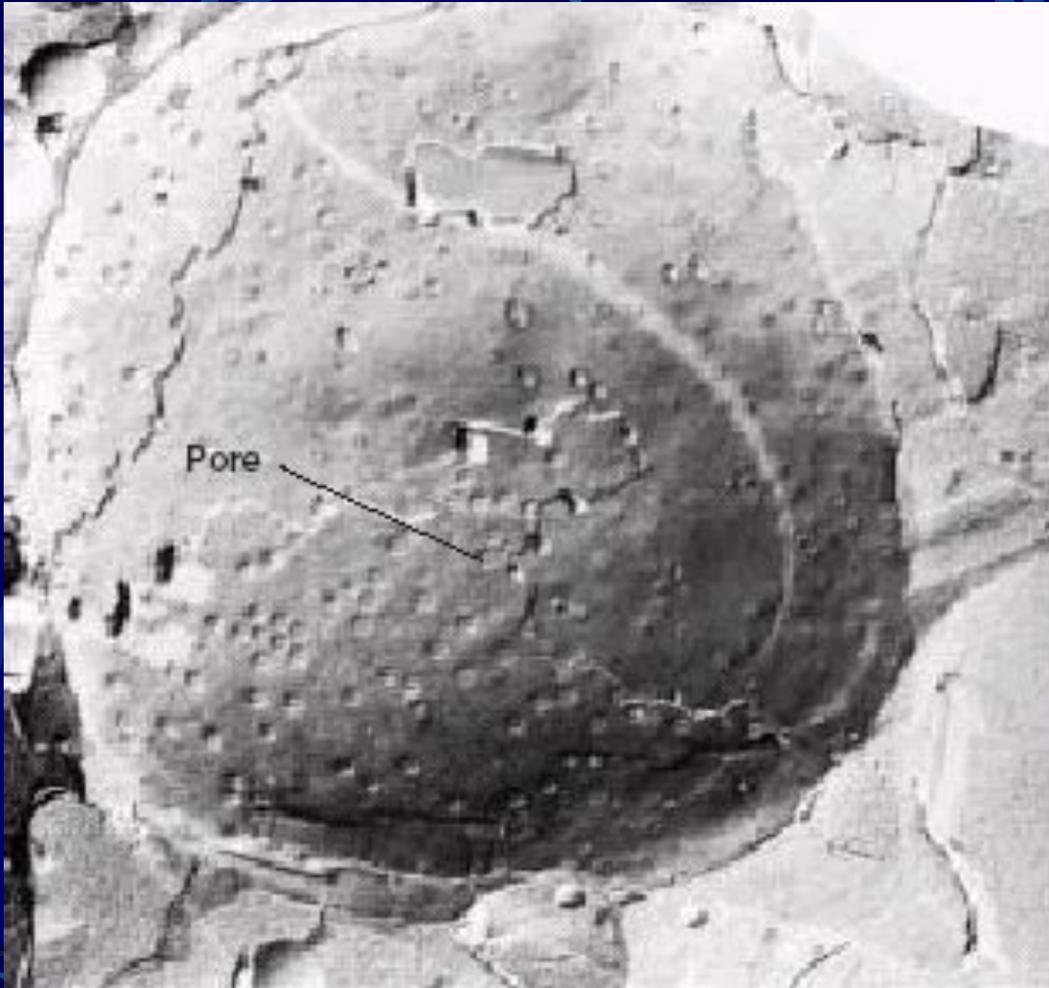
Клеточное ядро. Строение и уровни компактизации хроматина.
Клеточный цикл. Митоз и мейоз



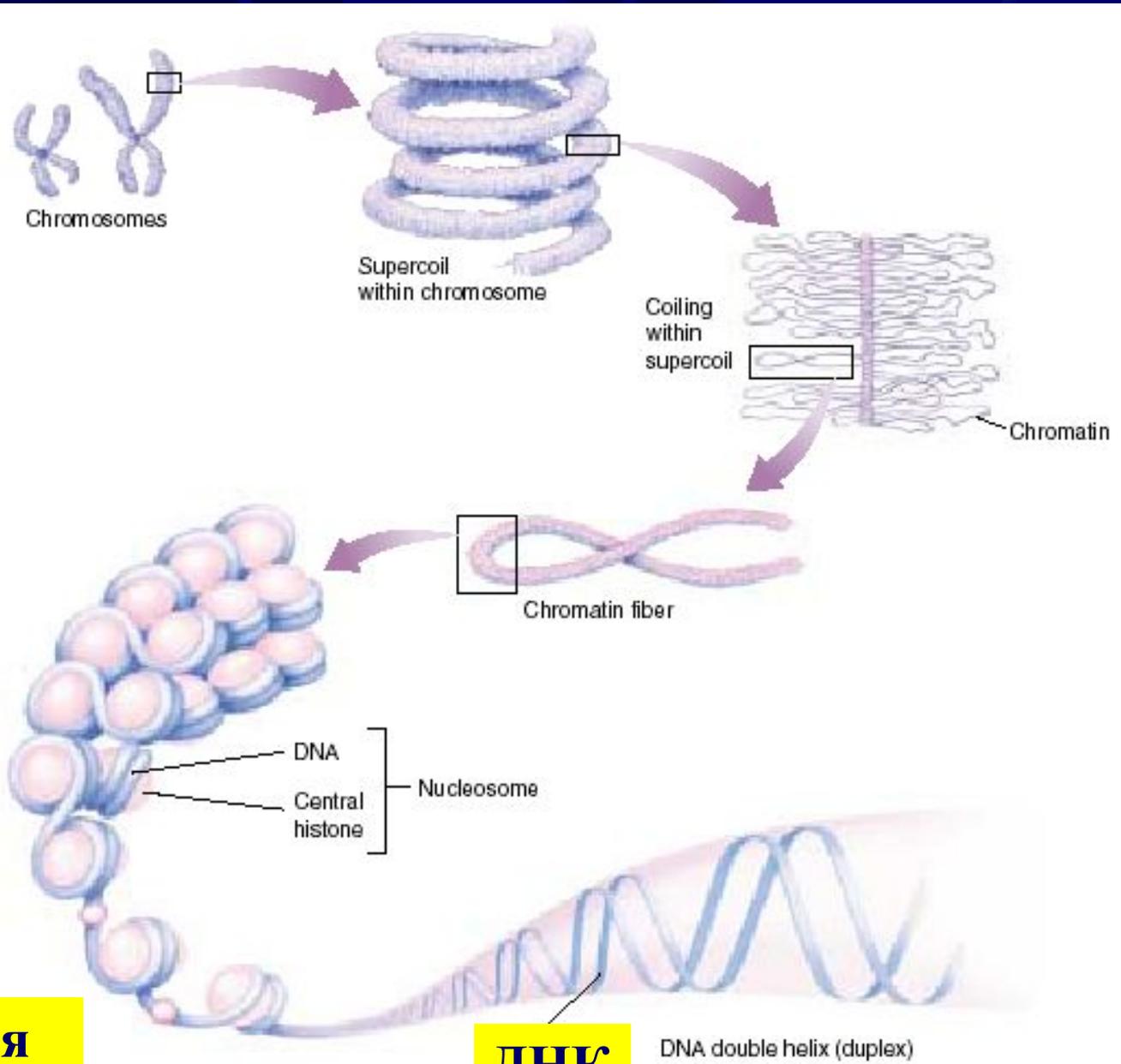
Структура клеточного ядра



Структура клеточного ядра: поровый комплекс



(c)



**Нуклеосомная
нить**

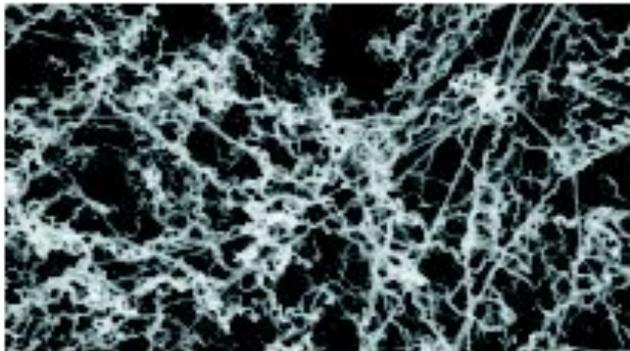
ДНК

DNA double helix (duplex)

Степень компактизации хроматина в процессе митотического цикла:

Интерфаза

(a) Uncondensed DNA



(b) DNA condensed into chromosomes

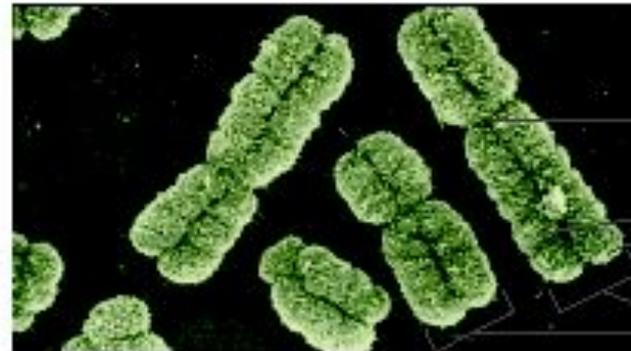
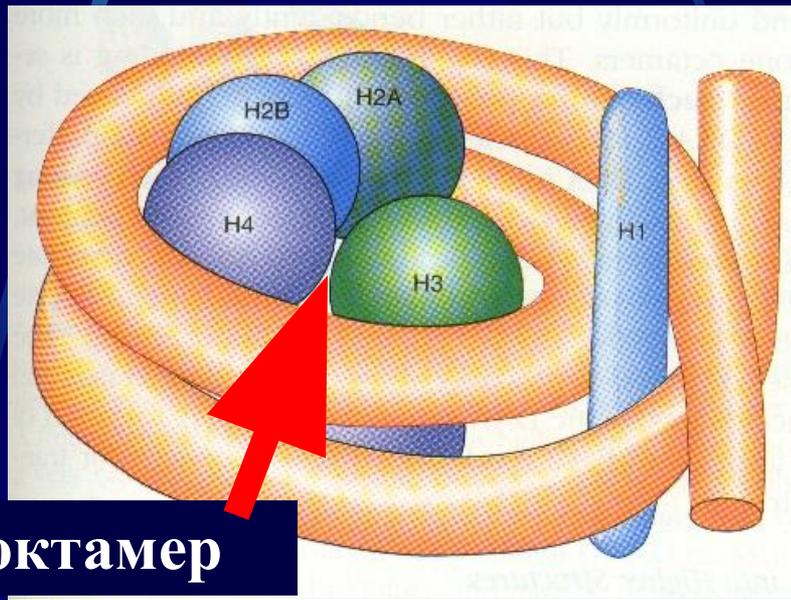


Figure 5.4 DNA condenses at the beginning of mitosis. (a) DNA in its replicated but uncondensed form. (b) During condensation, each copy of DNA wraps itself neatly around many small proteins, forming a condensed structure called a *chromosome*. After DNA synthesis, two identical sister chromatids are produced, and joined to each other by a region called the *centromere*.

Метафаза

Уменьшение в длину в 6.000 раз
Увеличение в ширину в 600 раз

Первый уровень укладки молекулы ДНК - нуклеосомная нить



октамер

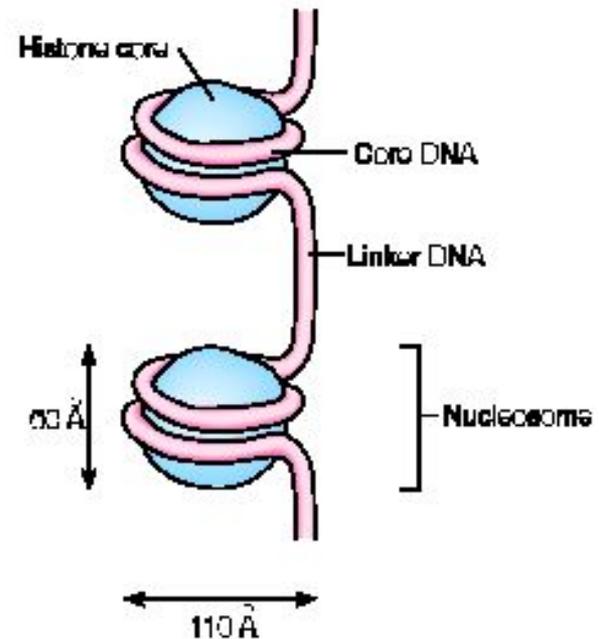


Figure 15.5 The eukaryotic chromosome is associated with histone proteins to form nucleosomes. The protein core is wrapped with 1.7 loops of DNA and connected with a length of DNA called a linker.

Нуклеосомная нить



Второй уровень укладки ДНК (нуклеомерный)

хроматиновая фибрилла

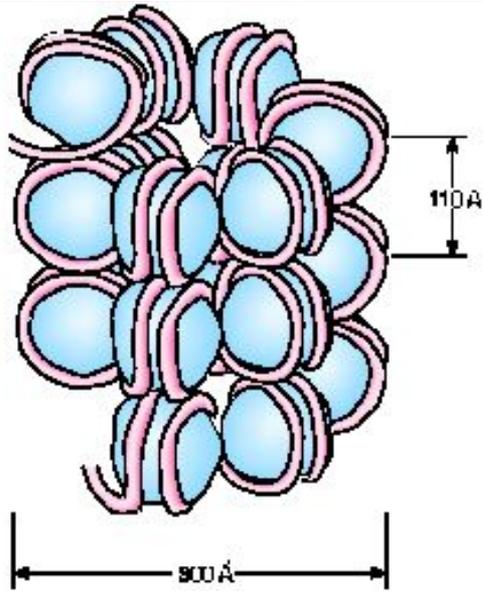
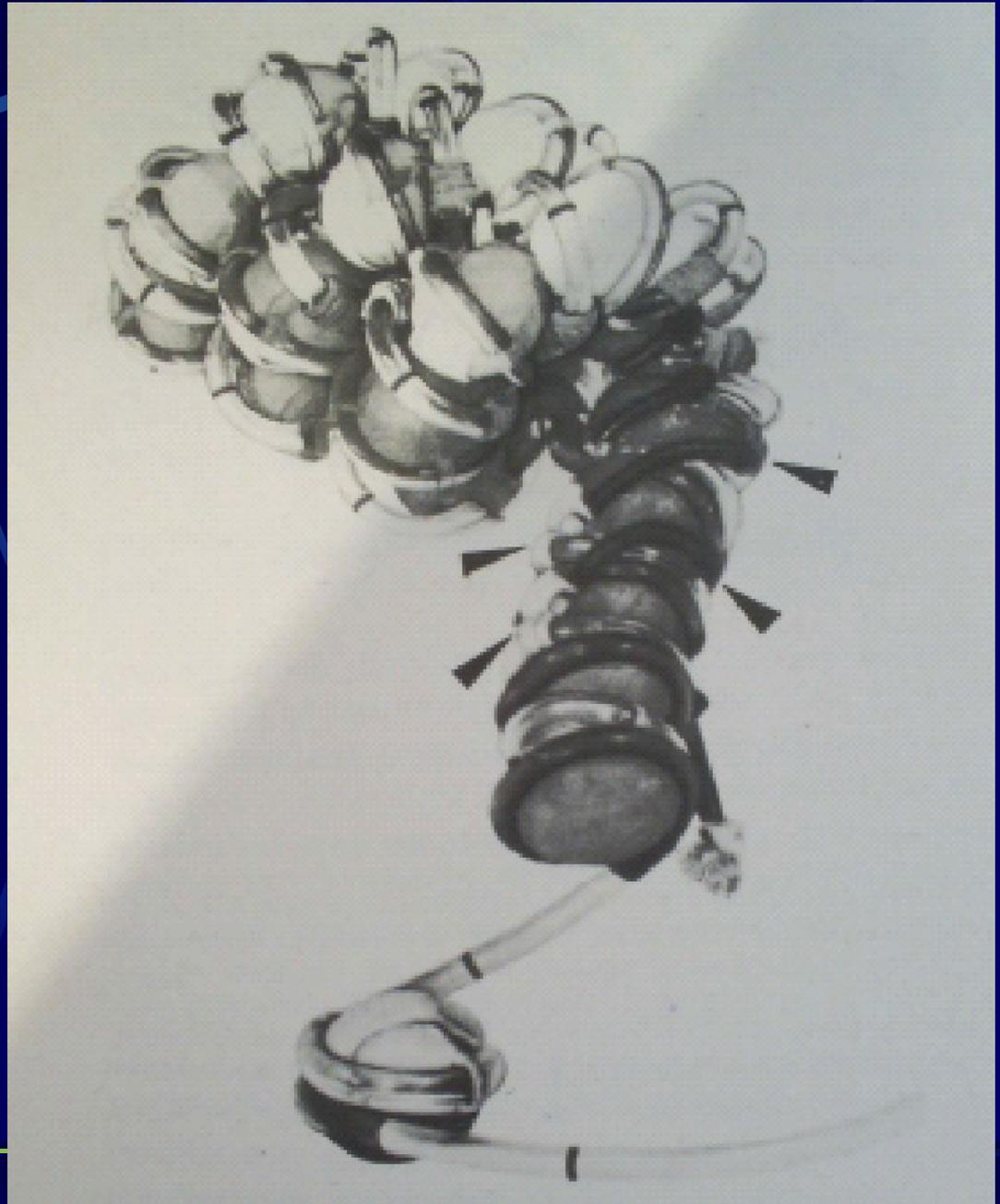
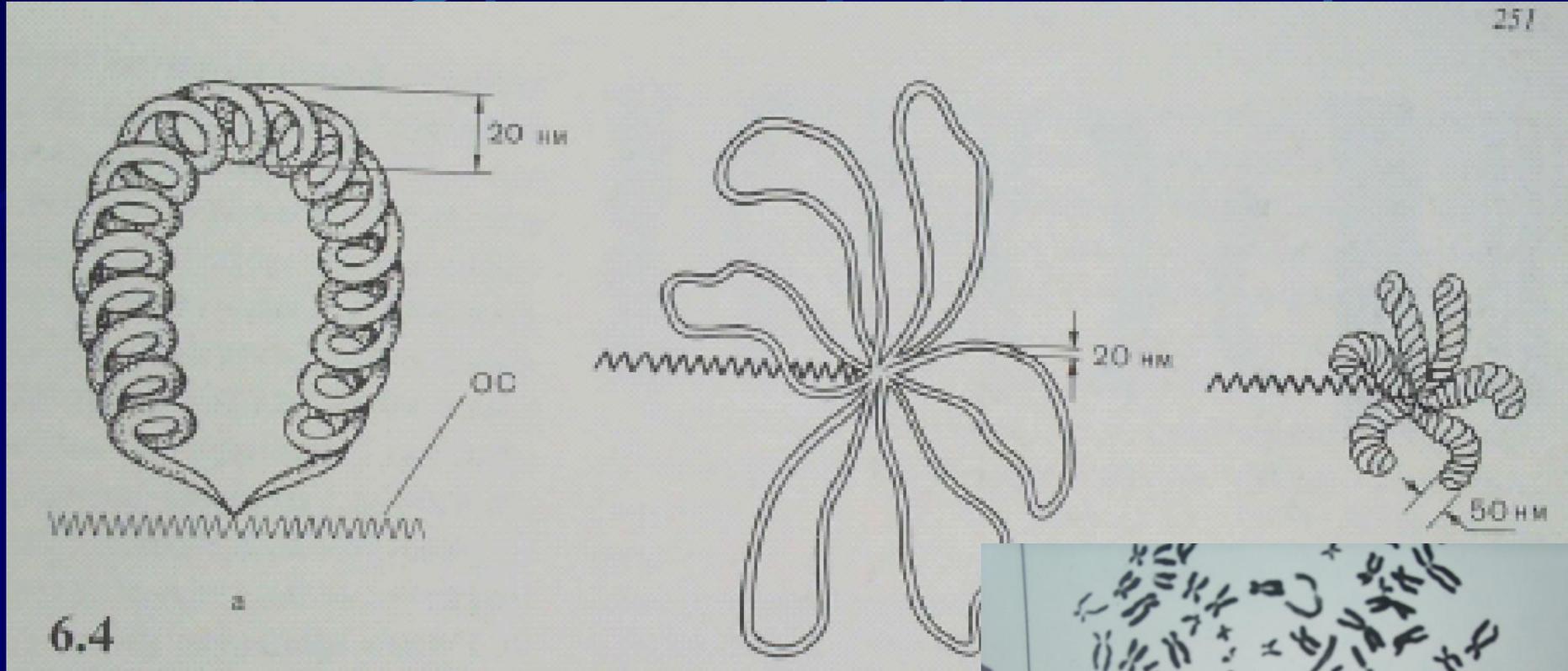


Figure 15.10 Solenoid model for the formation of the 300 Å chromatin fiber. Nucleosomal DNA wraps in a helical fashion, forming a hollow core. Although histone H1 is not shown, it is known to be on the inside of the solenoid.



Третий уровень укладки молекулы ДНК – петлевой

251



профаза →

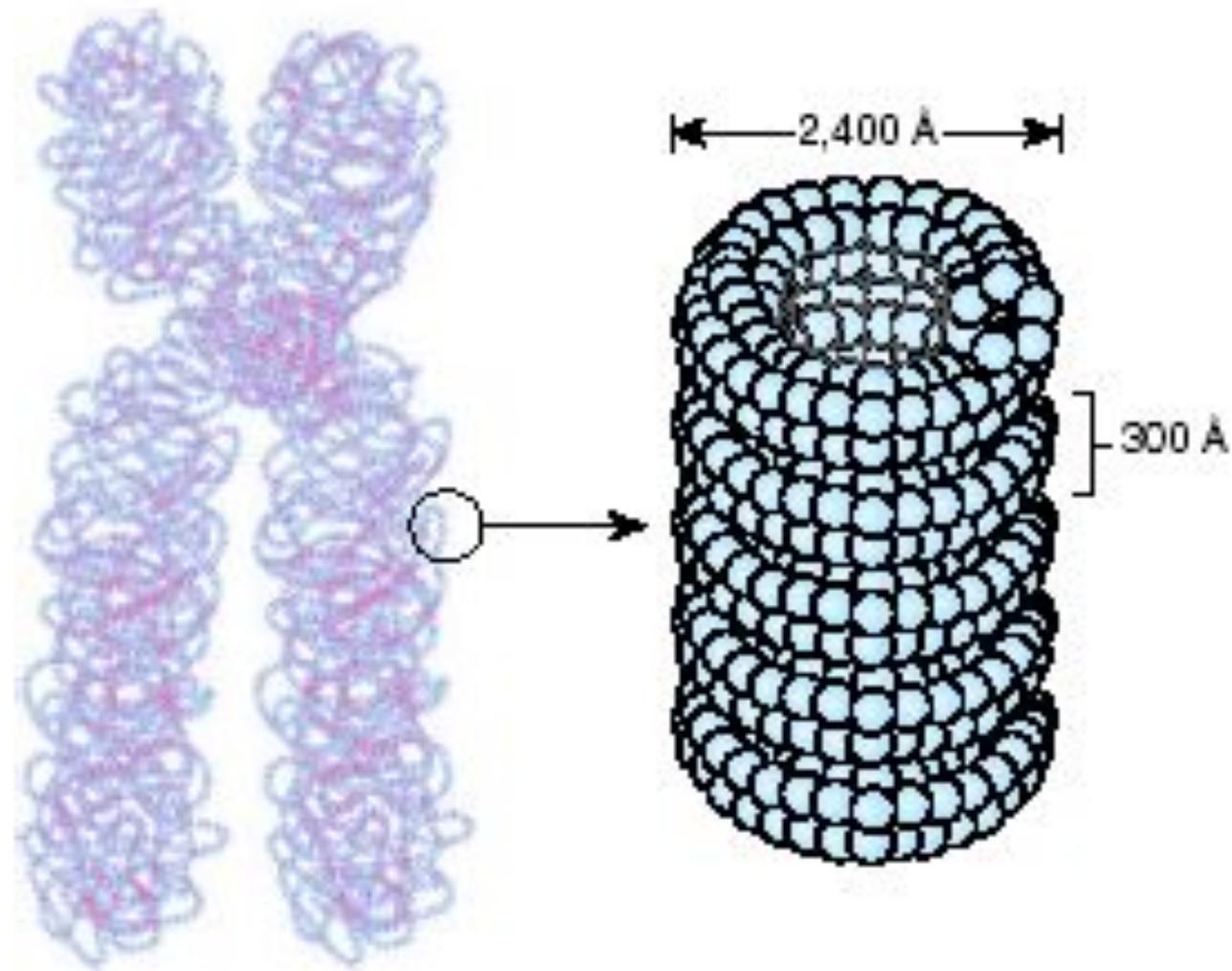


Figure 15.11 The 2,400 Å fiber of the eukaryotic chromosome is a hollow, solenoidlike structure. It is formed by the coiling of the 300 Å fiber, which itself is a solenoid.

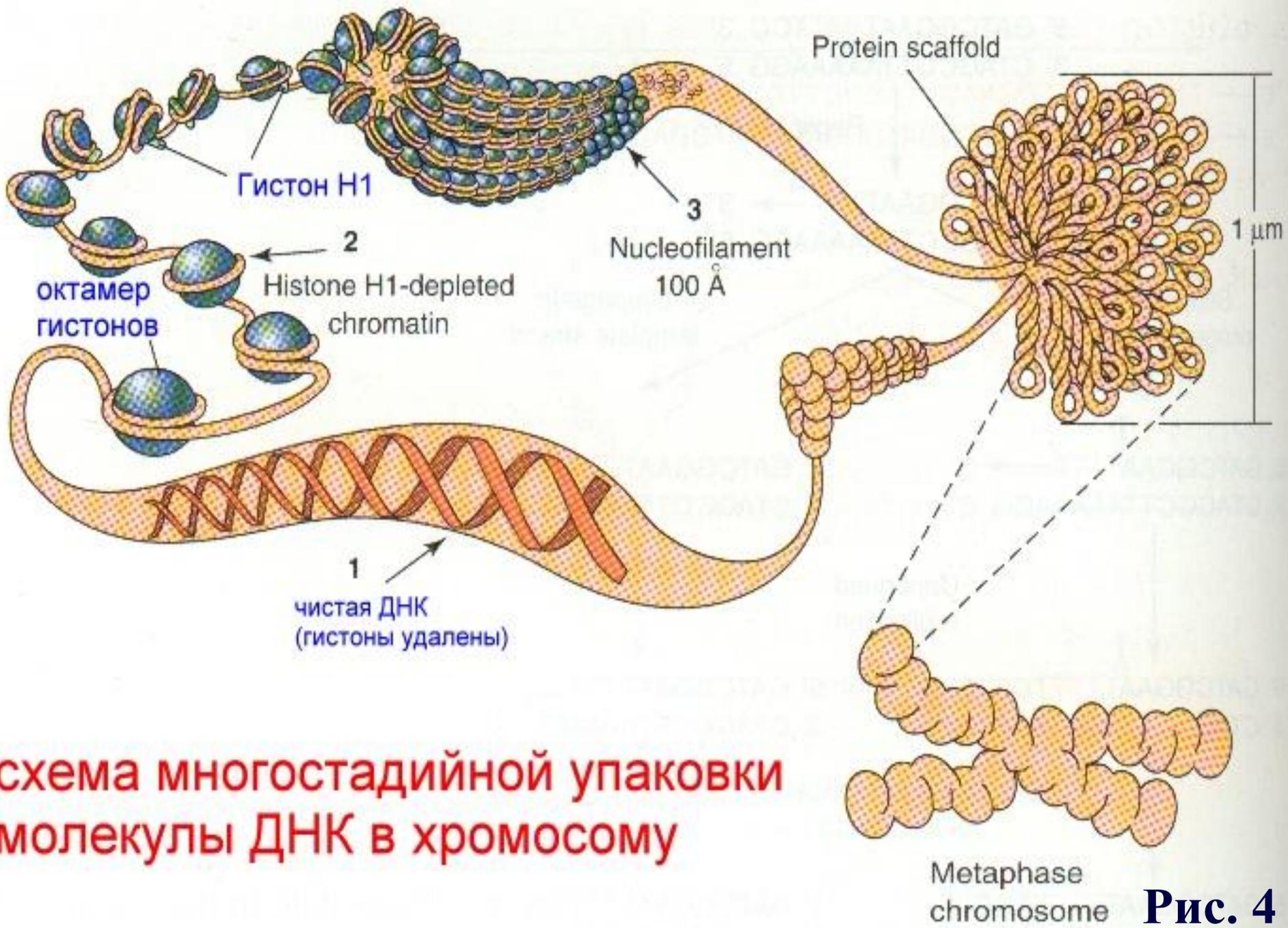
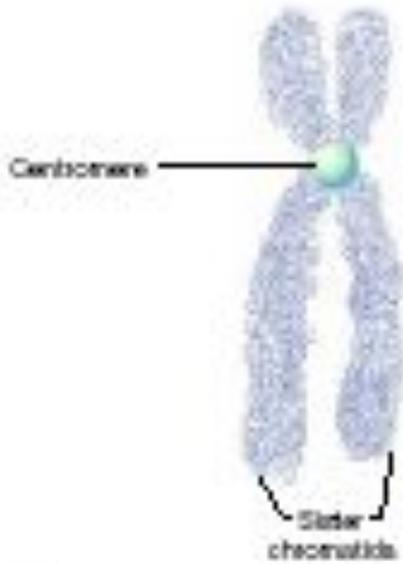
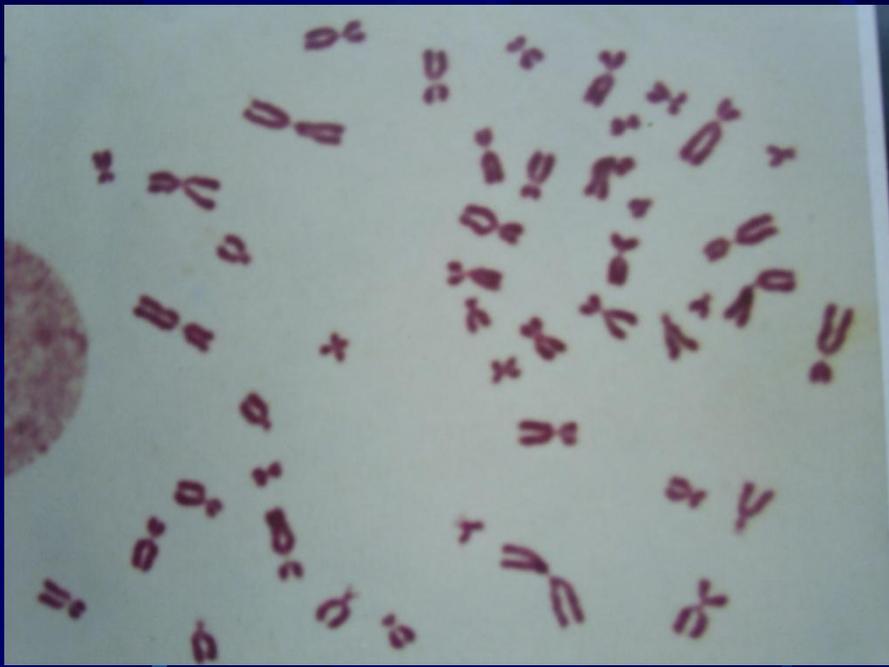


схема многостадийной упаковки молекулы ДНК в хромосому

Рис. 4

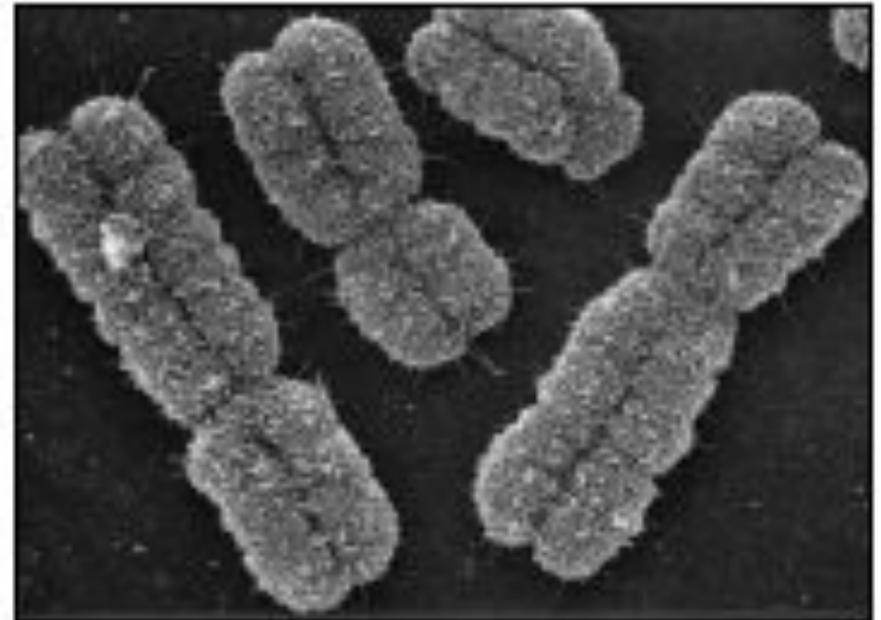
Метафазная пластинка – максимальная компактизация хроматина



[a]



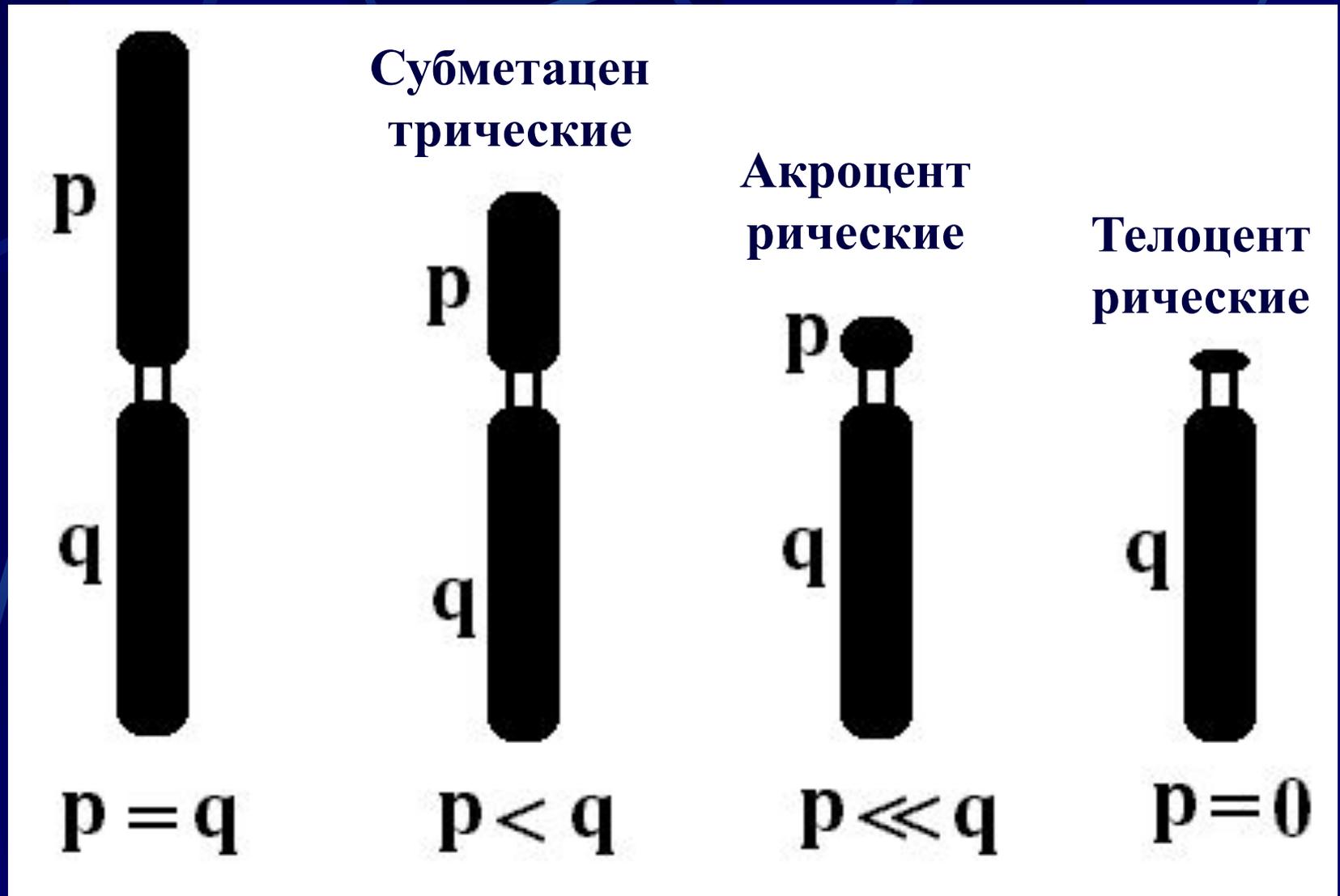
[b]



[c]

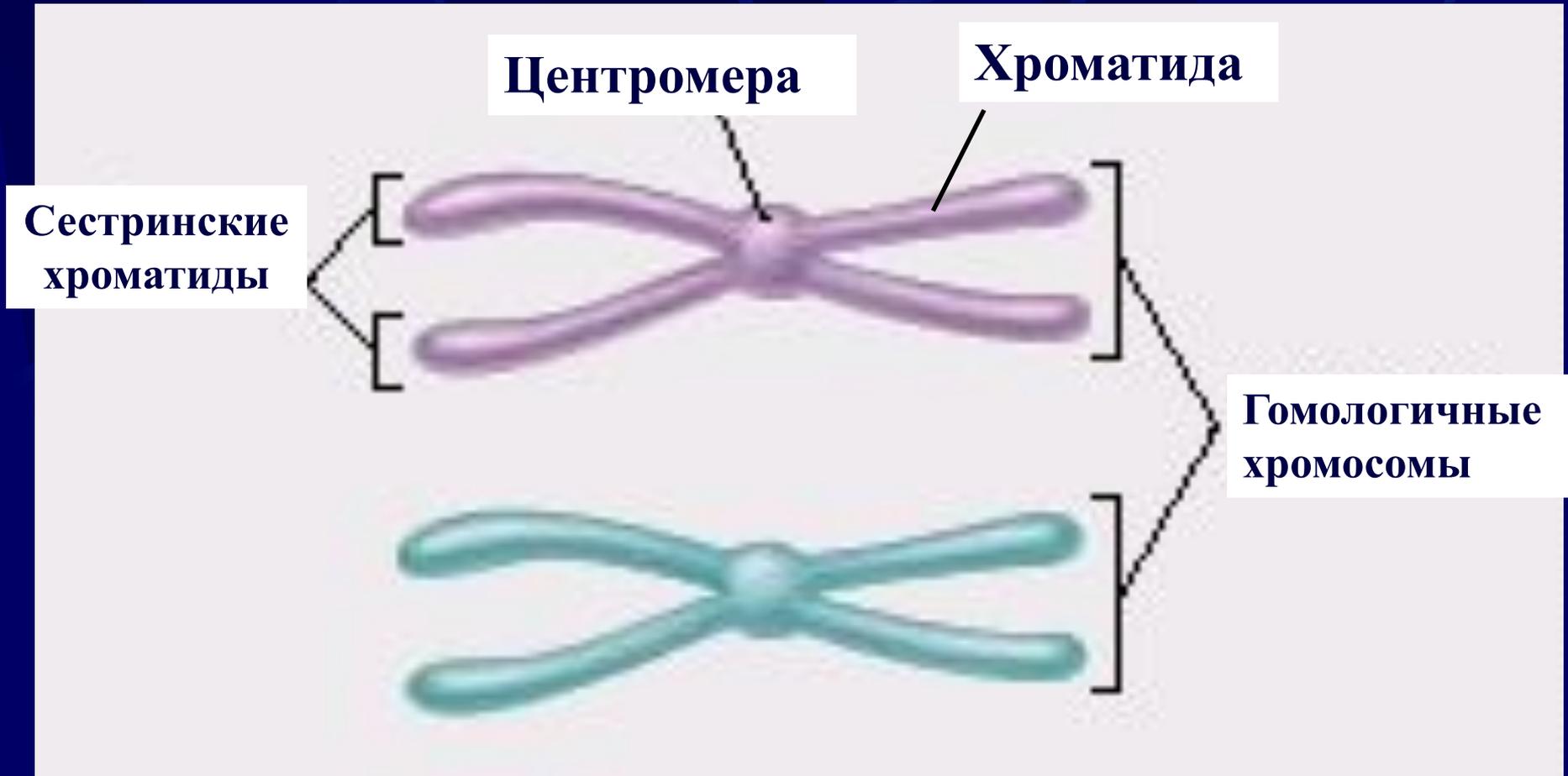
700 nm

Морфология равномерно окрашенных хромосом



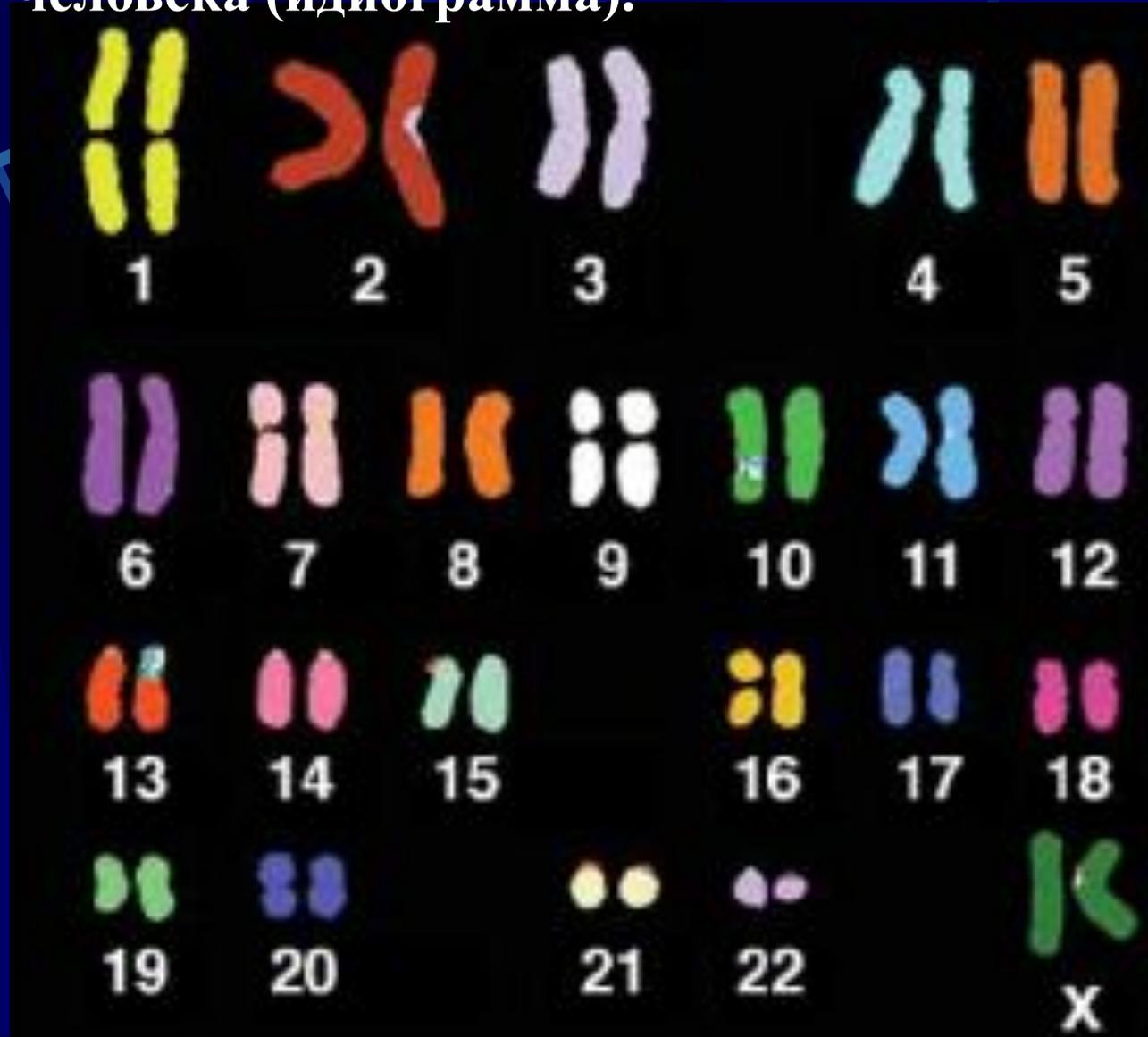
Метацентрические

Рис. 6



Различие между гомологичными хромосомами и сестринскими хроматидами

Кариотип человека (идиограмма).



The karyotype shows 23 pairs of chromosomes, including the sex chromosomes. This female's sex chromosomes are X and X; a male would have X and Y chromosomes.

МИТОЗ

Nuclear division occurs during mitosis.

Mitosis (M)

Cell division—cytokinesis—is distinct from nuclear division and occurs at the end of the M phase.

Gap 2 (G2)

Gap 1 (G1)

G1- рост, начало дифференцировки

G2 - подготовка к делению

S – synthesis (репликация ДНК)

G0 – окончательная дифференцировка и специализация, выполнение специфических функций

гибель

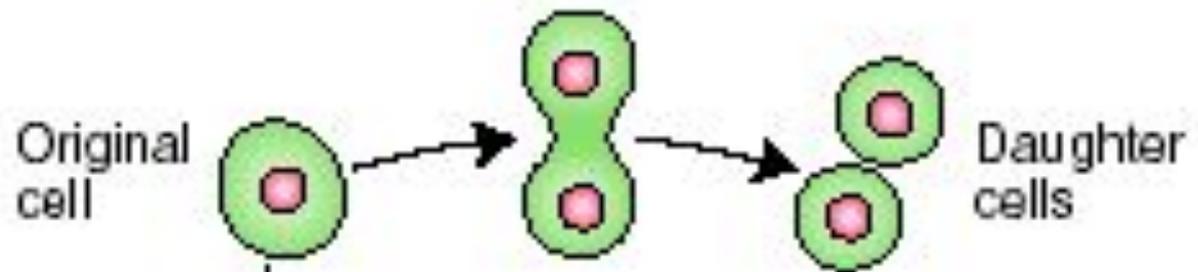
Interphase

DNA synthesis (S)

DNA is replicated during the S phase, between the G1 and G2 phases.

Cells that do not divide are usually arrested in the G1 phase.

9.3 The Eukaryotic Cell Cycle The cell cycle consists of a mitotic (M) phase, during which first nuclear division (mitosis) and then cell division (cytokinesis) take place. The M phase is followed by a long period of growth known as interphase. Interphase has three sub-phases (G1, S, and G2) in cells that divide.

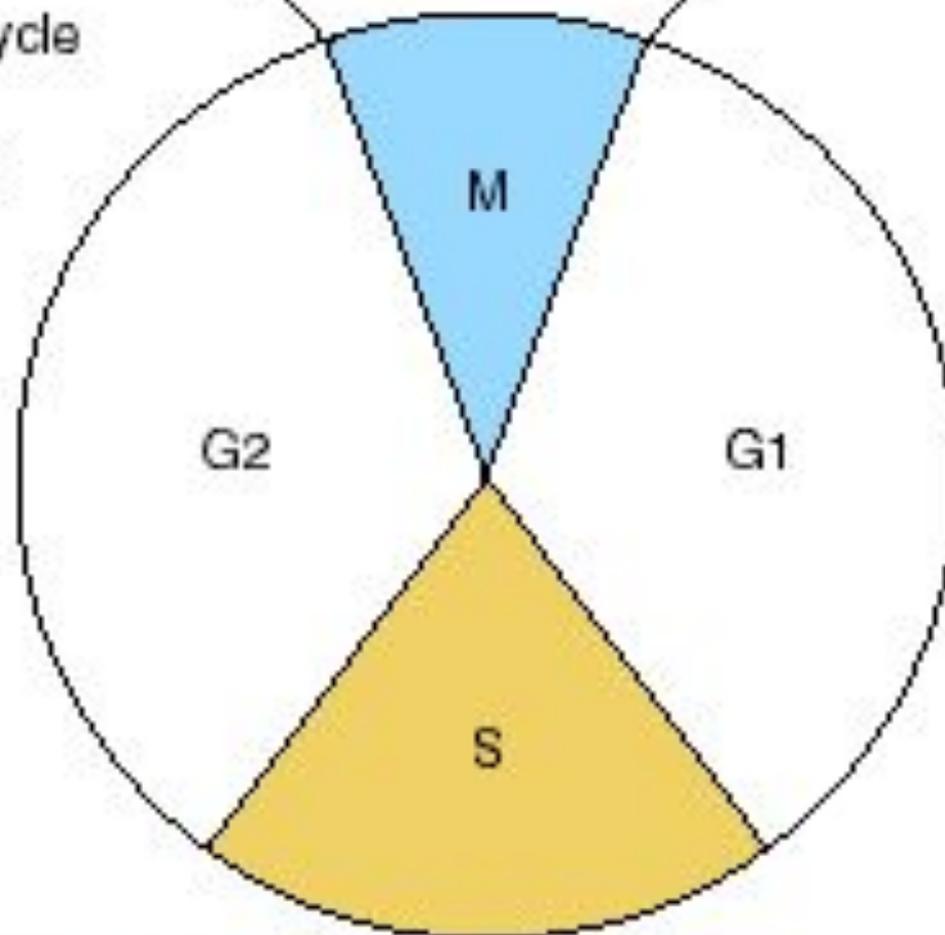


Stages of the cell cycle

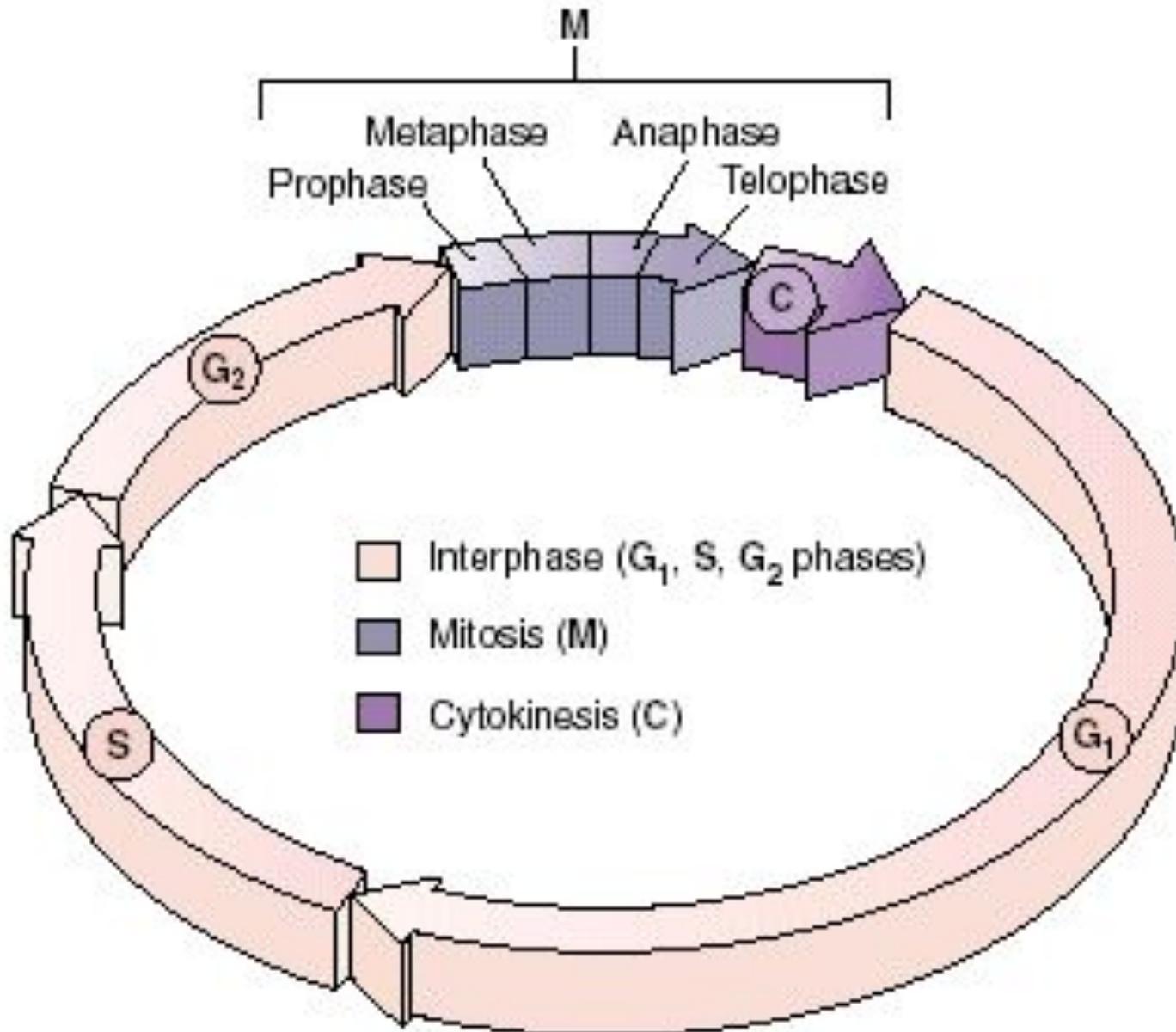
M = mitosis

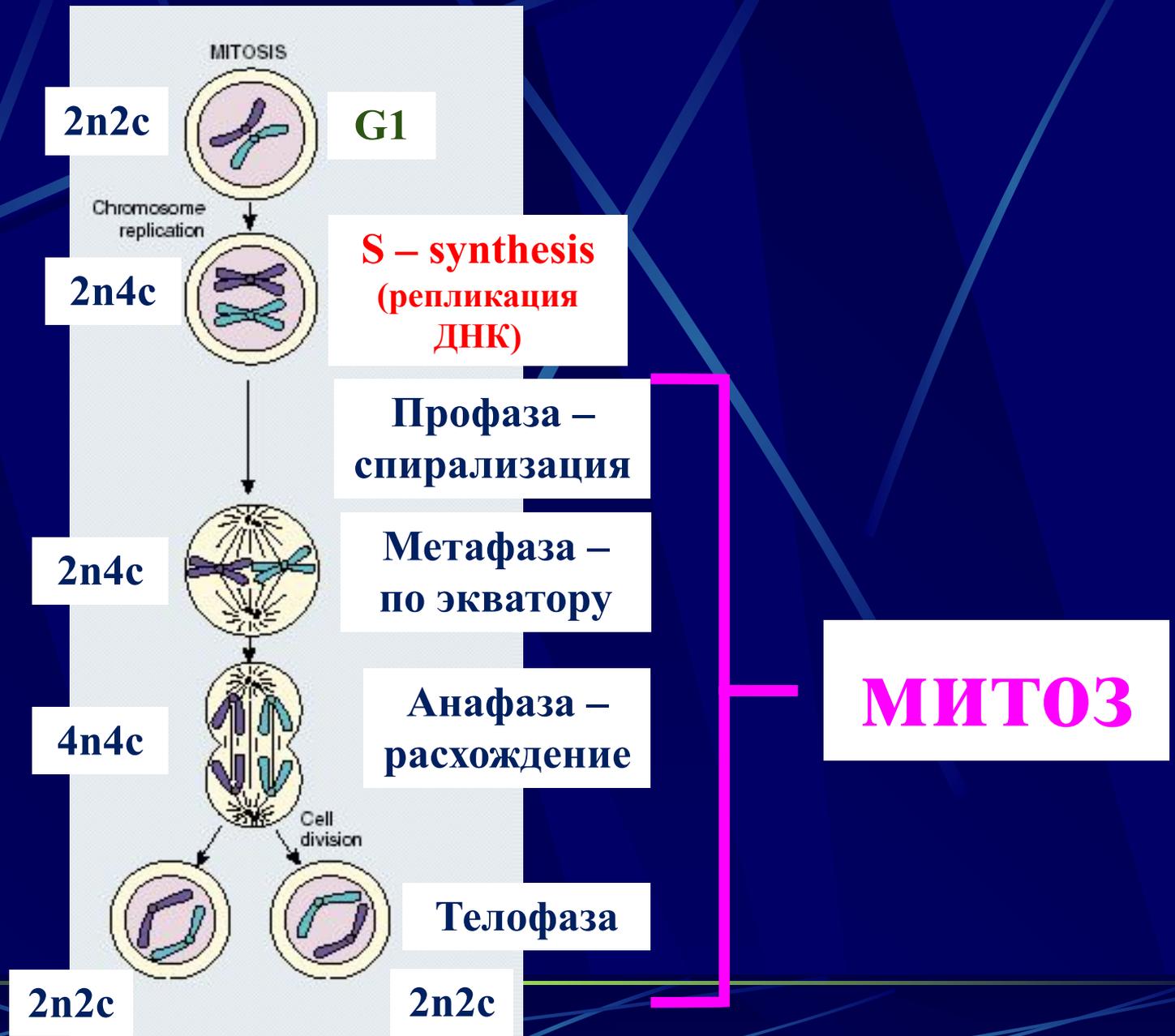
S = DNA synthesis

G = gap

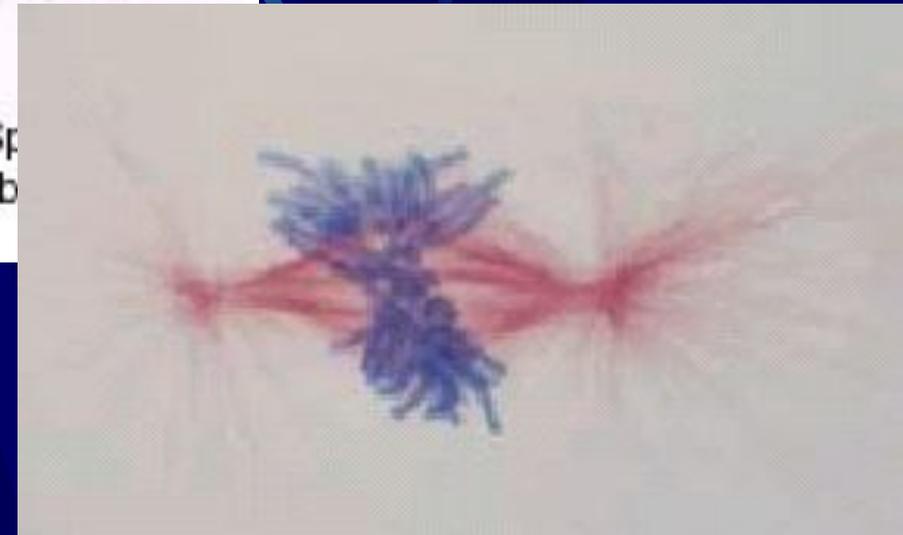
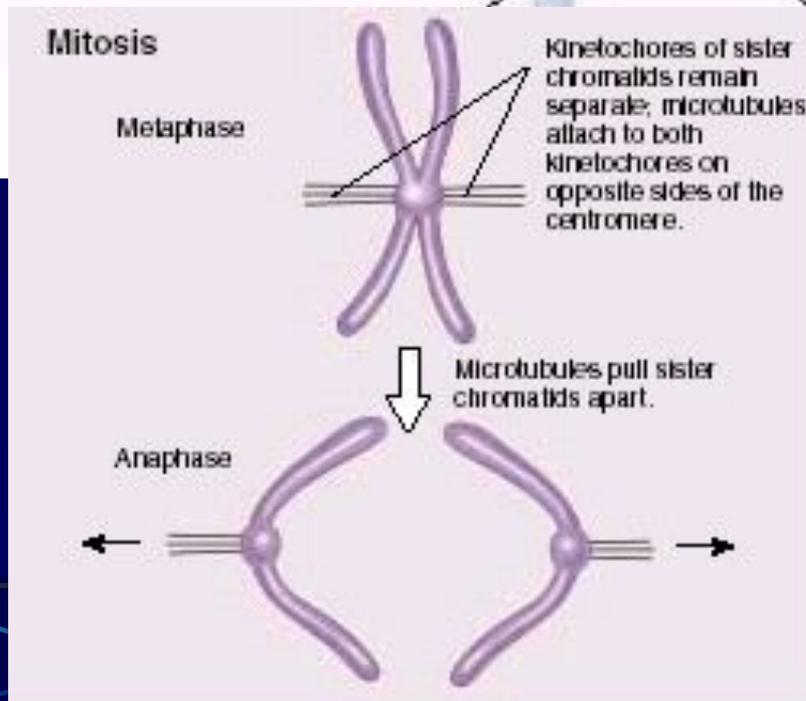
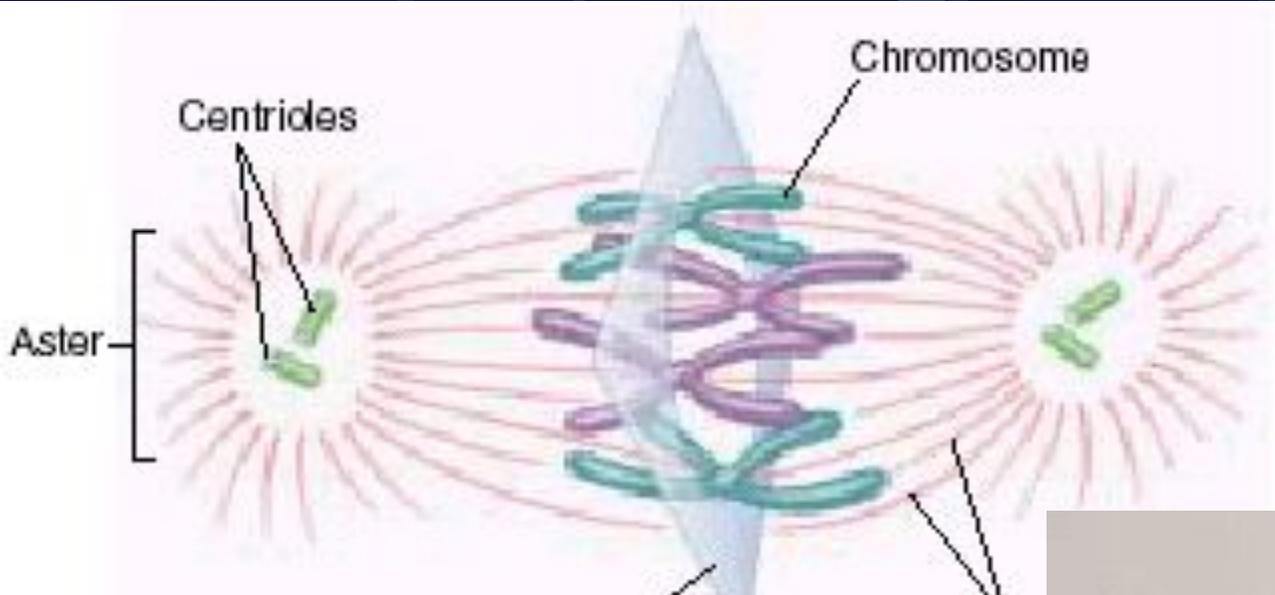


Митотический цикл клетки





Метафаза митоза.



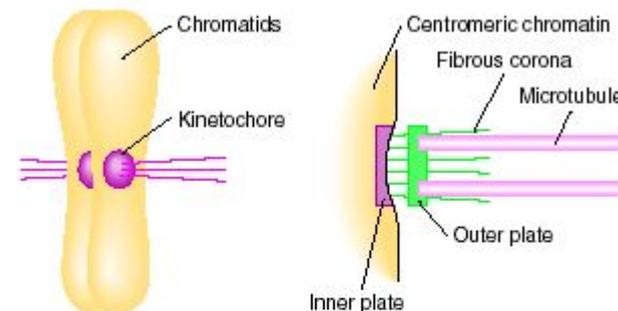
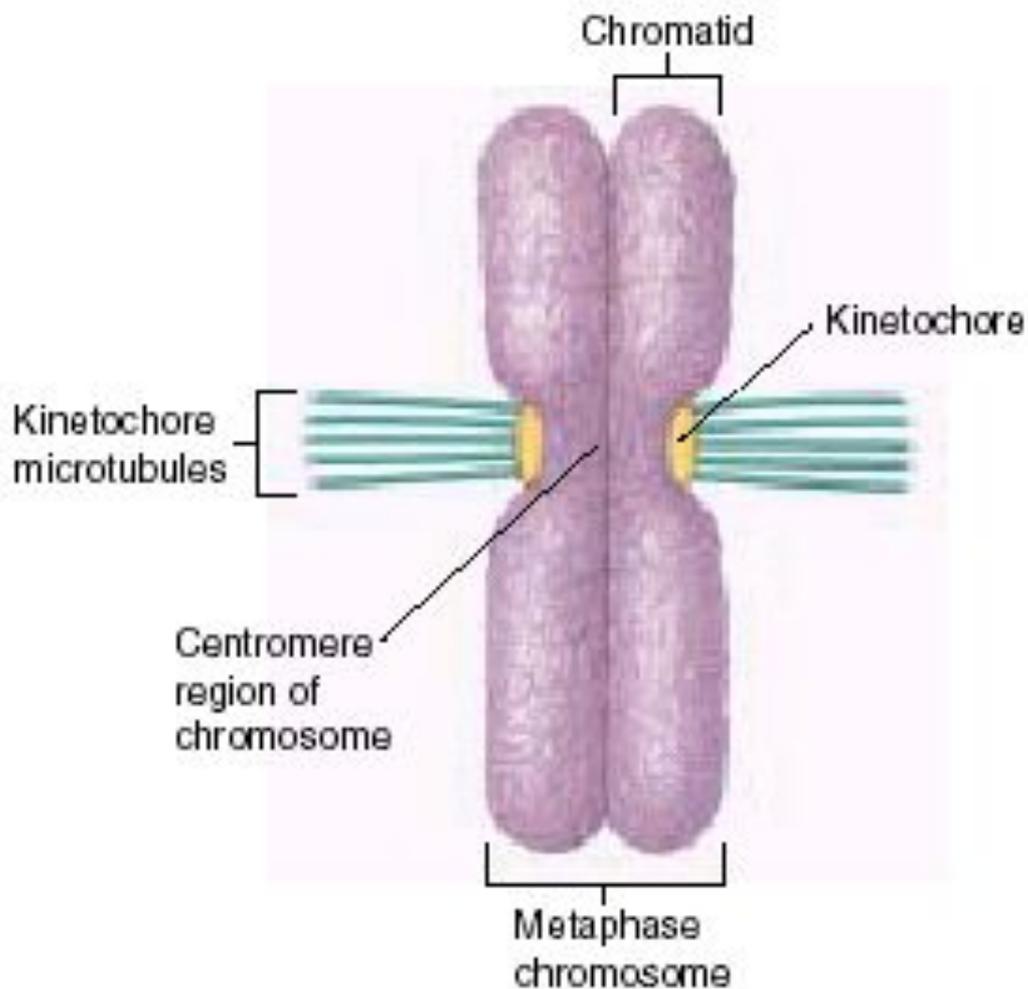


Figure 3-26 Microtubule attachment to the kinetochore.

Microtubules are attached to the kinetochore at the centromere region of the chromatid in animal cells. The kinetochore is composed of an inner and outer plate and a fibrous corona. [Adapted from A. G. Pluta et al., *Science* 270, 1995, 1592; taken from H. Lodish, A. Berk, S. L. Zipursky, P. Matsudaira, D. Baltimore, and J. Darnell, *Molecular Cell Biology*, 4th ed. Copyright 2000 by W. H. Freeman and Company.]

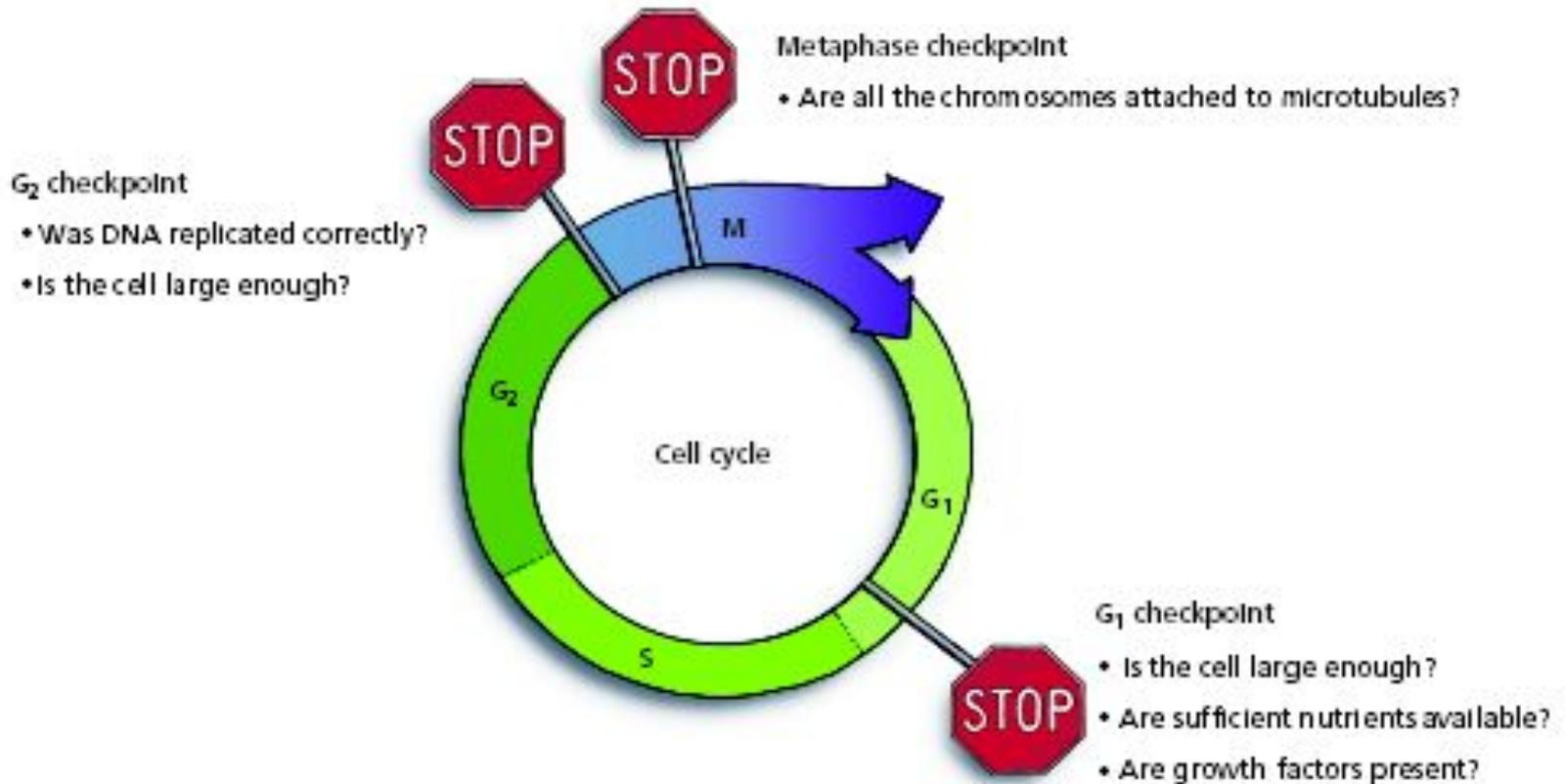
Прикрепление микротрубочек веретена деления к кинетохору, расположенному в области центромеры хромосом.

Биологическое значение митоза

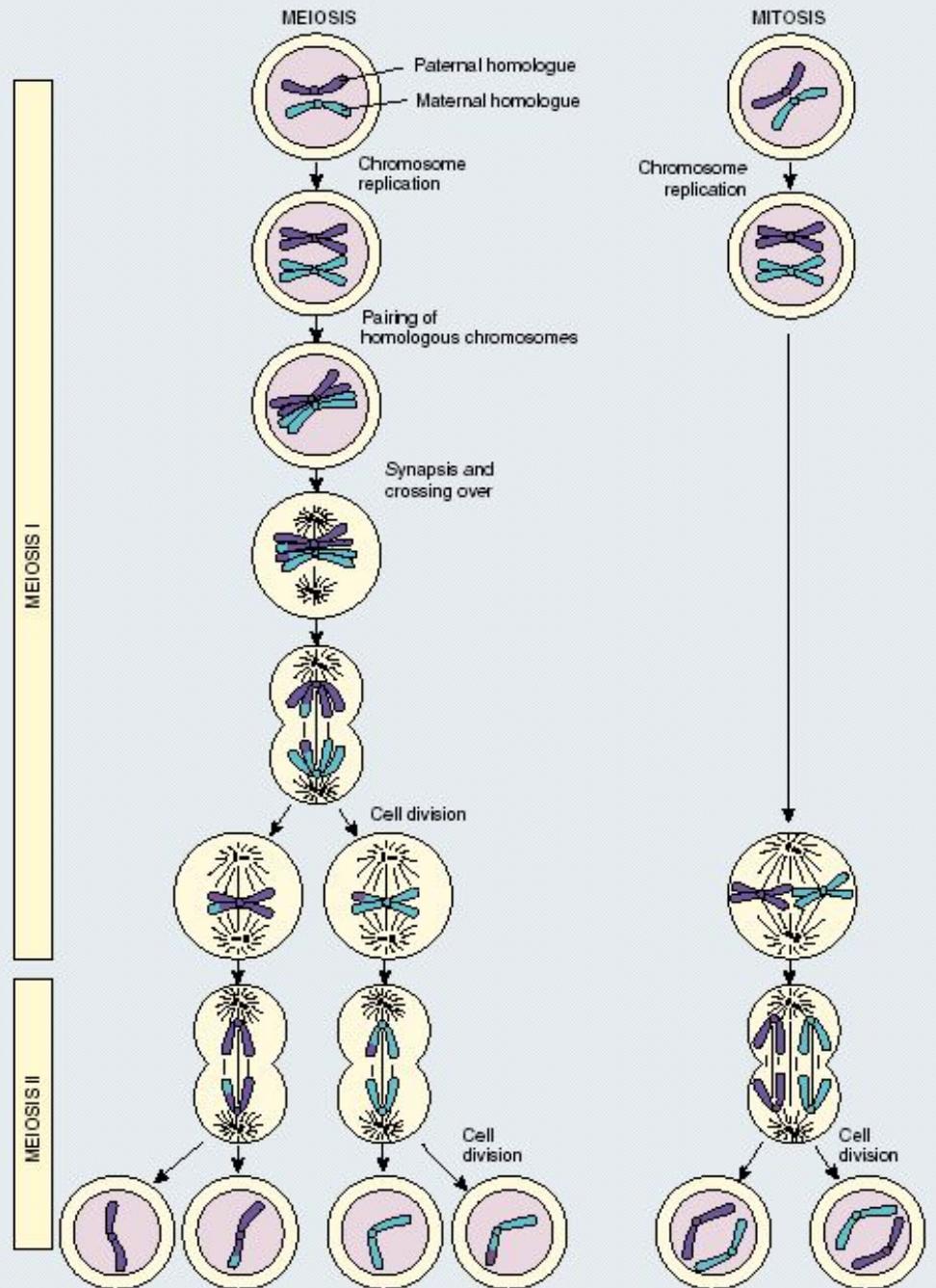
- * В результате митоза из одной материнской клетки образуются две генетически равноценные дочерние клетки, точно идентичные материнской.
- * Благодаря митозу поддерживается постоянство кариотипа (т.е. набора хромосом) в поколениях клеток.

Контроль клеточного цикла

(a) Control of the cell cycle



Отличие мейоза от митоза.



Биологическое значение мейоза

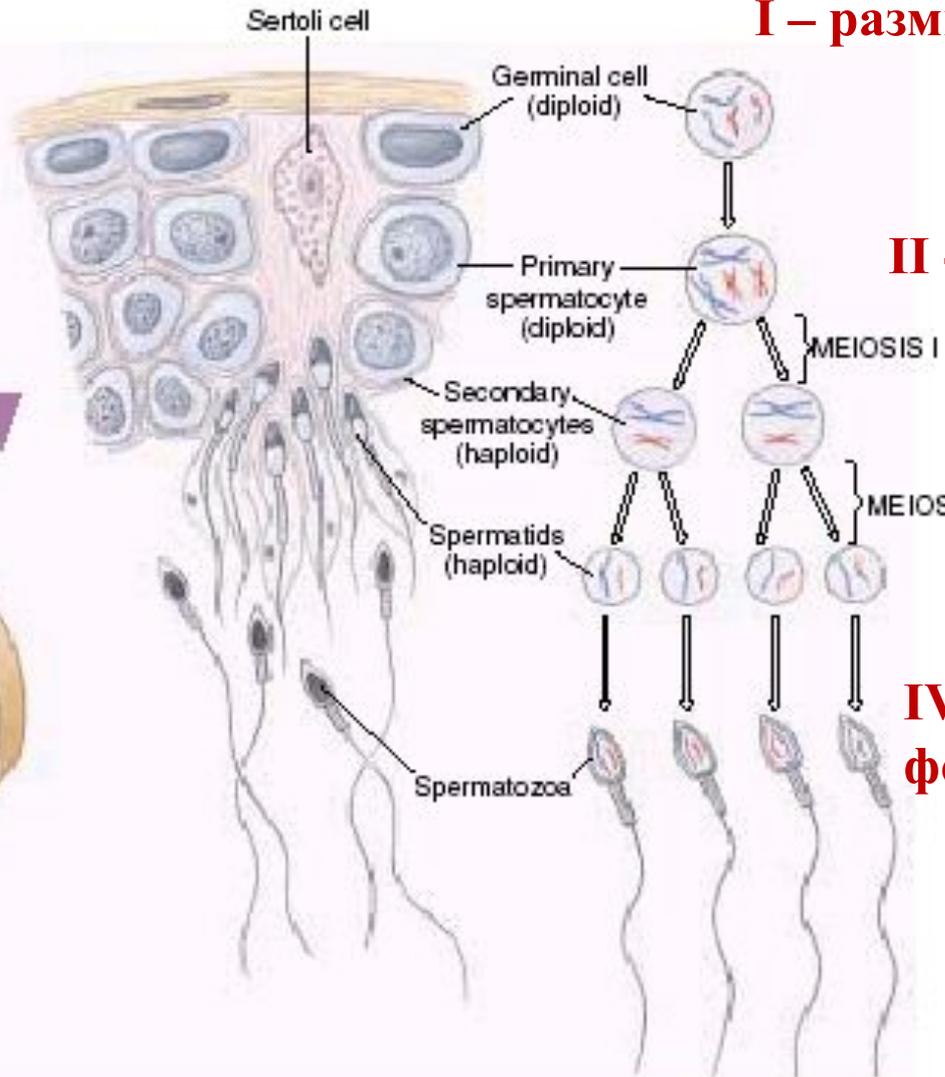
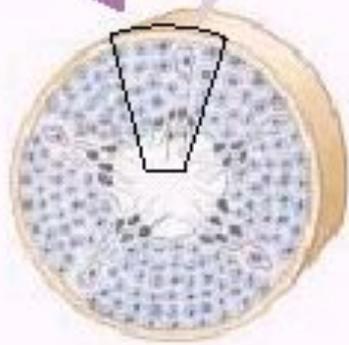
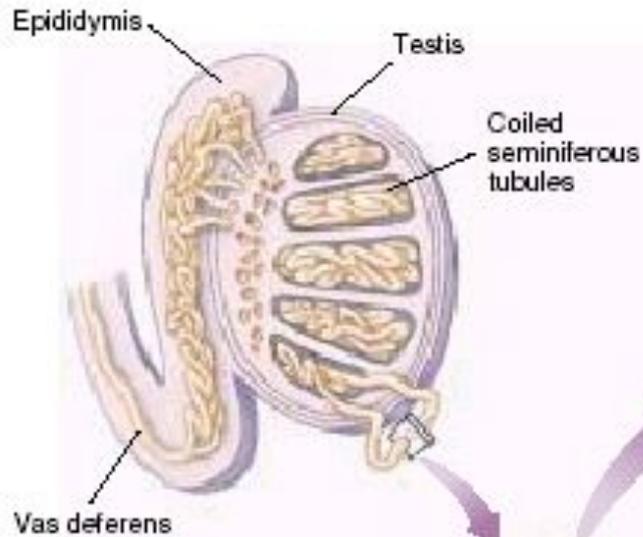
1. Благодаря мейозу во всех живых организмах при половом размножении поддерживается постоянство числа хромосом (кариотипа) в поколениях организмов.

2. Мейоз - мощный фактор комбинативной изменчивости:

1) Благодаря *кроссинговеру* происходит рекомбинация на уровне генов (отцовских и материнских) и образование качественно новых хромосом.

2) В связи с независимым расхождением отцовских и материнских хромосом в анафазе происходит *рекомбинация на уровне целых хромосом*

Сперматогенез



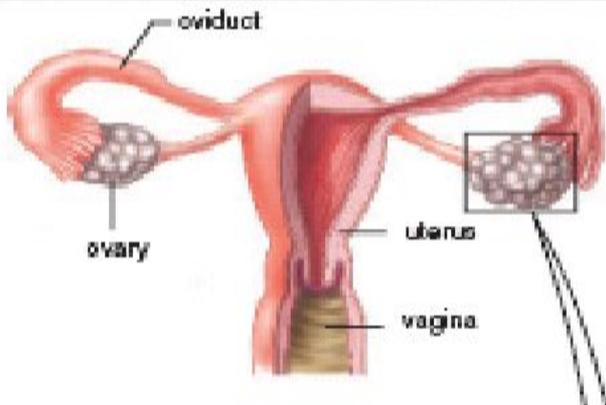
I – размножение

II – рост

III – созревание

IV – формирование

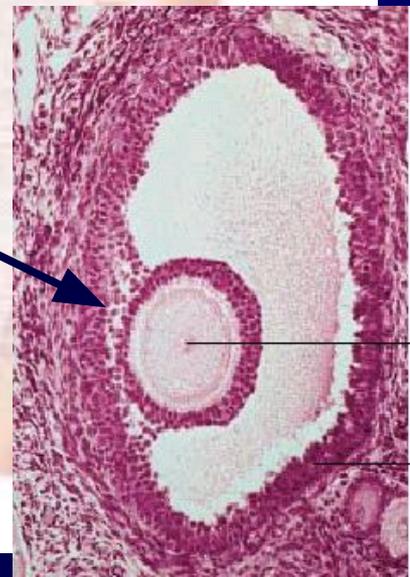
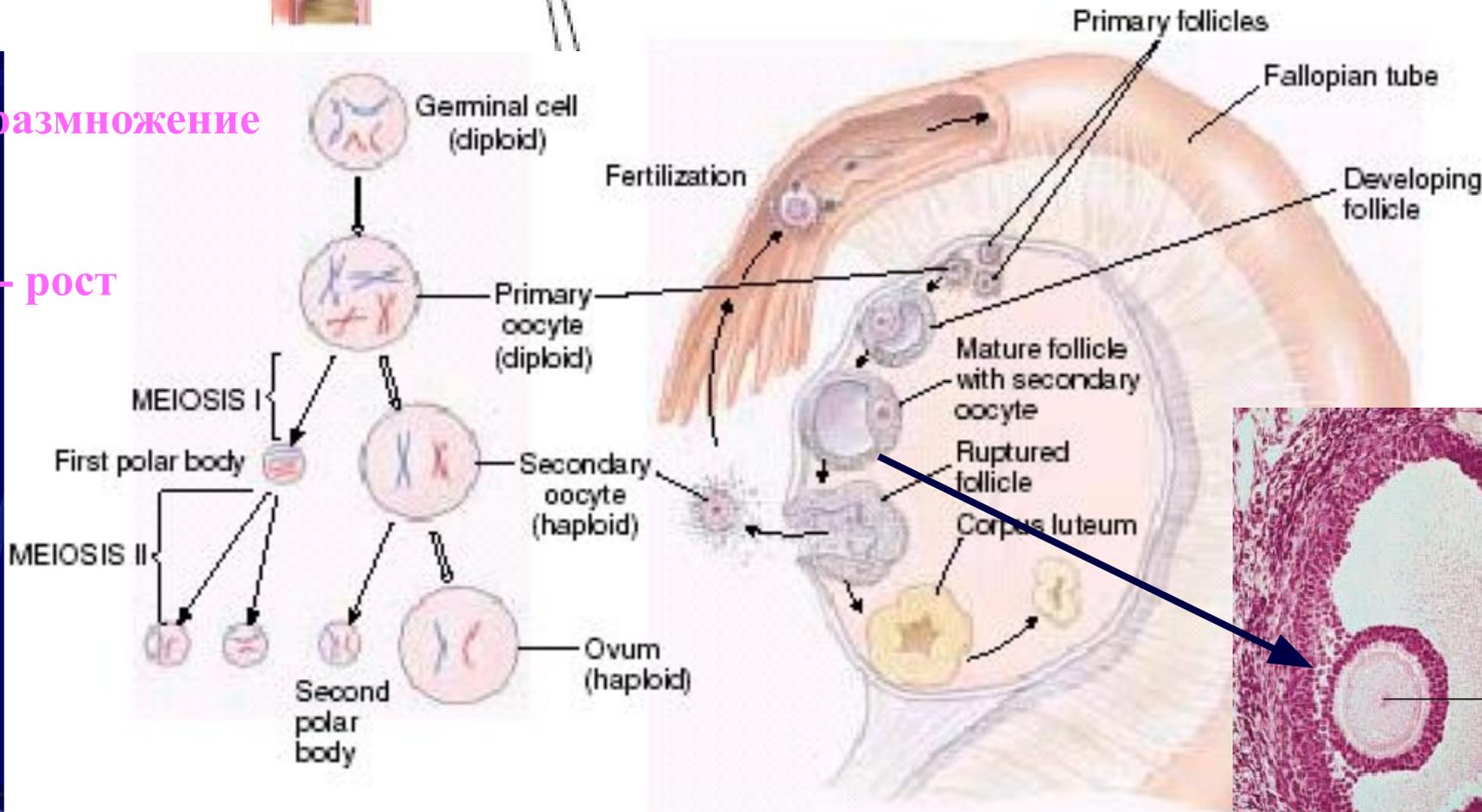
Этапы овогенеза



I - размножение

II - рост

III - созревание

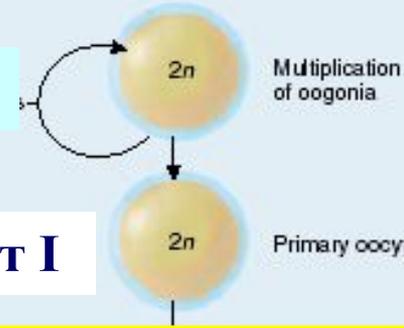


Овогенез

До рождения

Development of the egg (oogenesis)

Development of the follicle



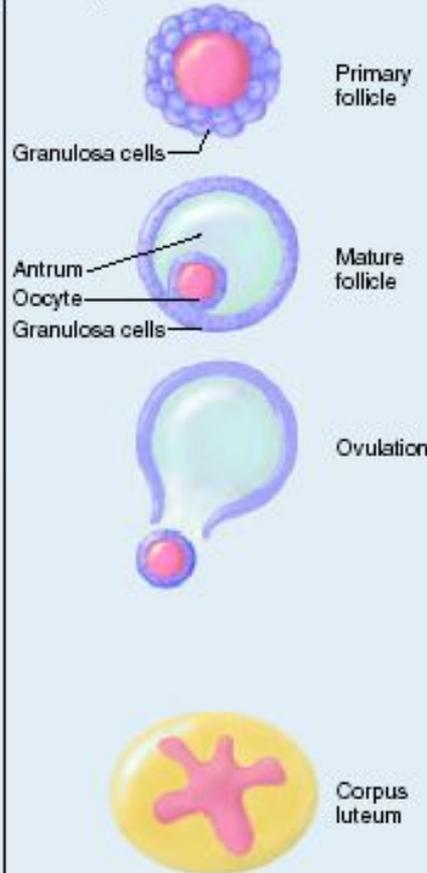
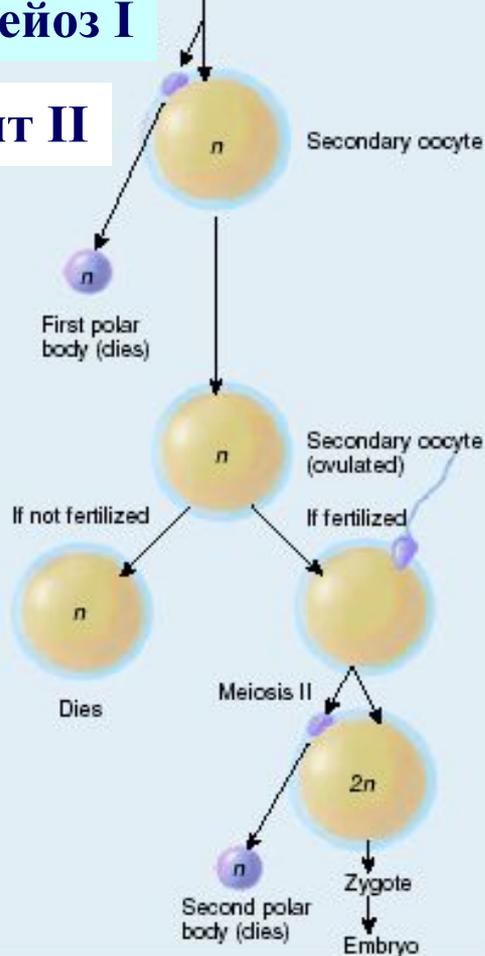
МИТОЗ

Овоцит I

Мейоз I

Овоцит II

Adolescence to menopause



После полового созревания

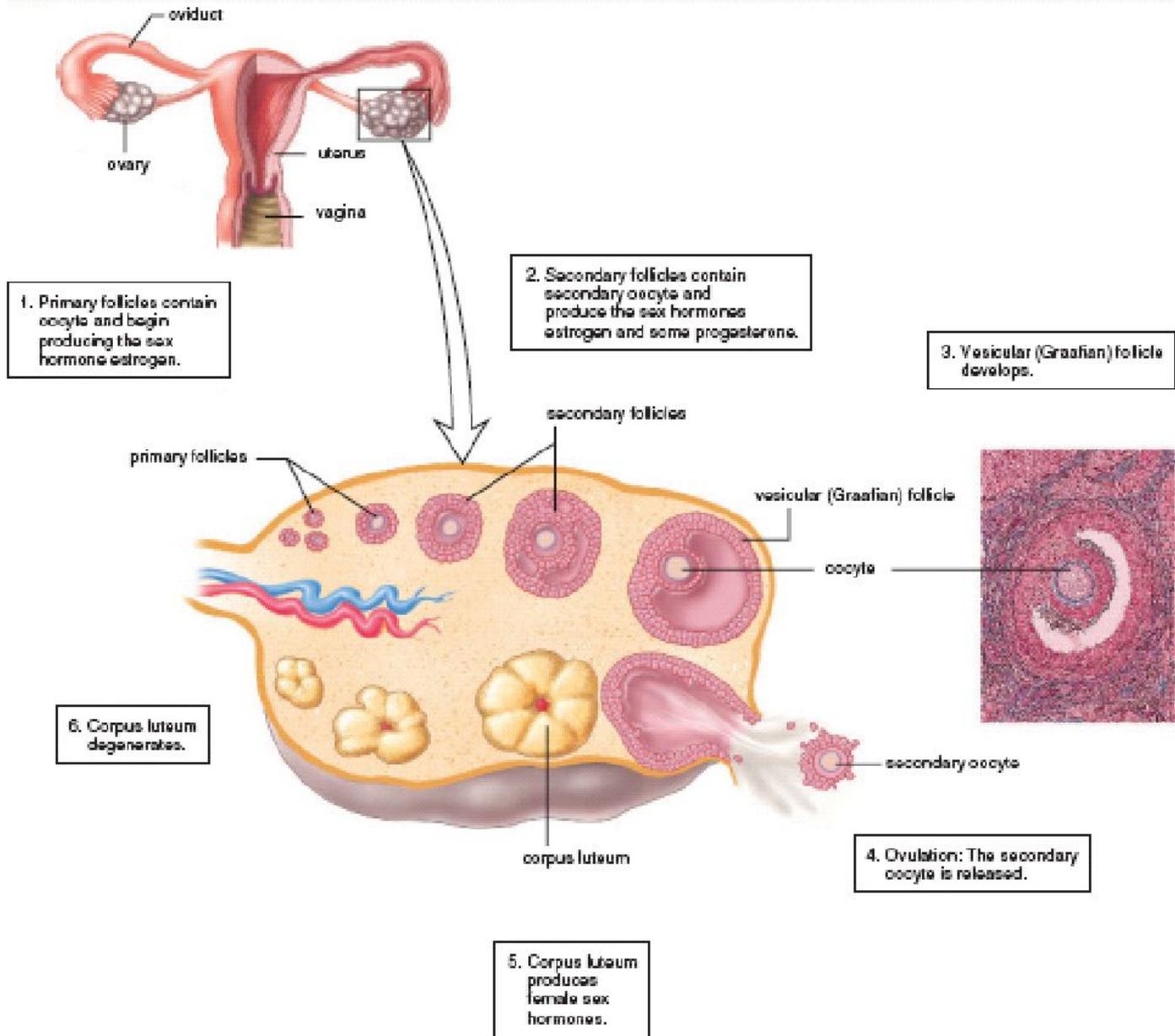
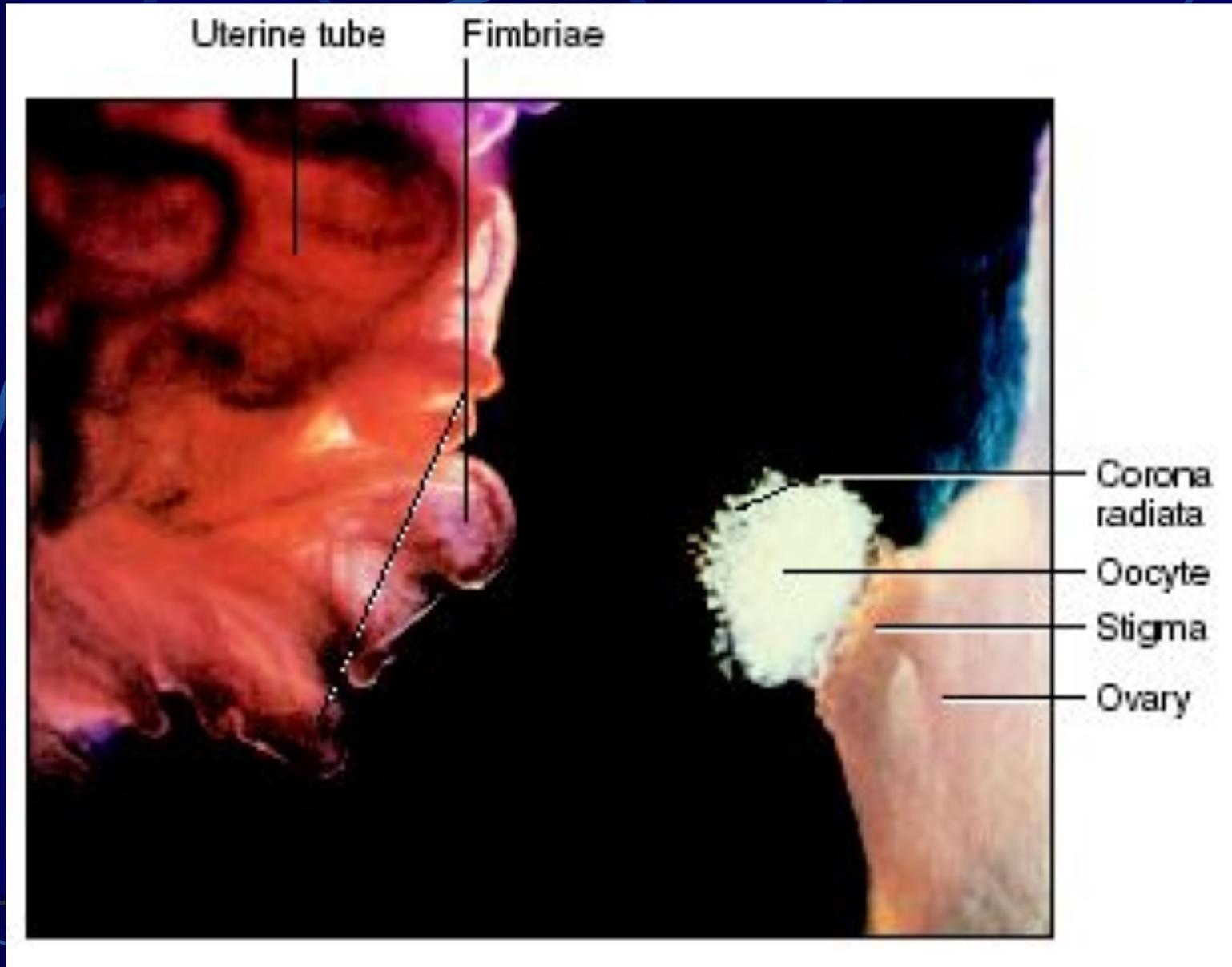
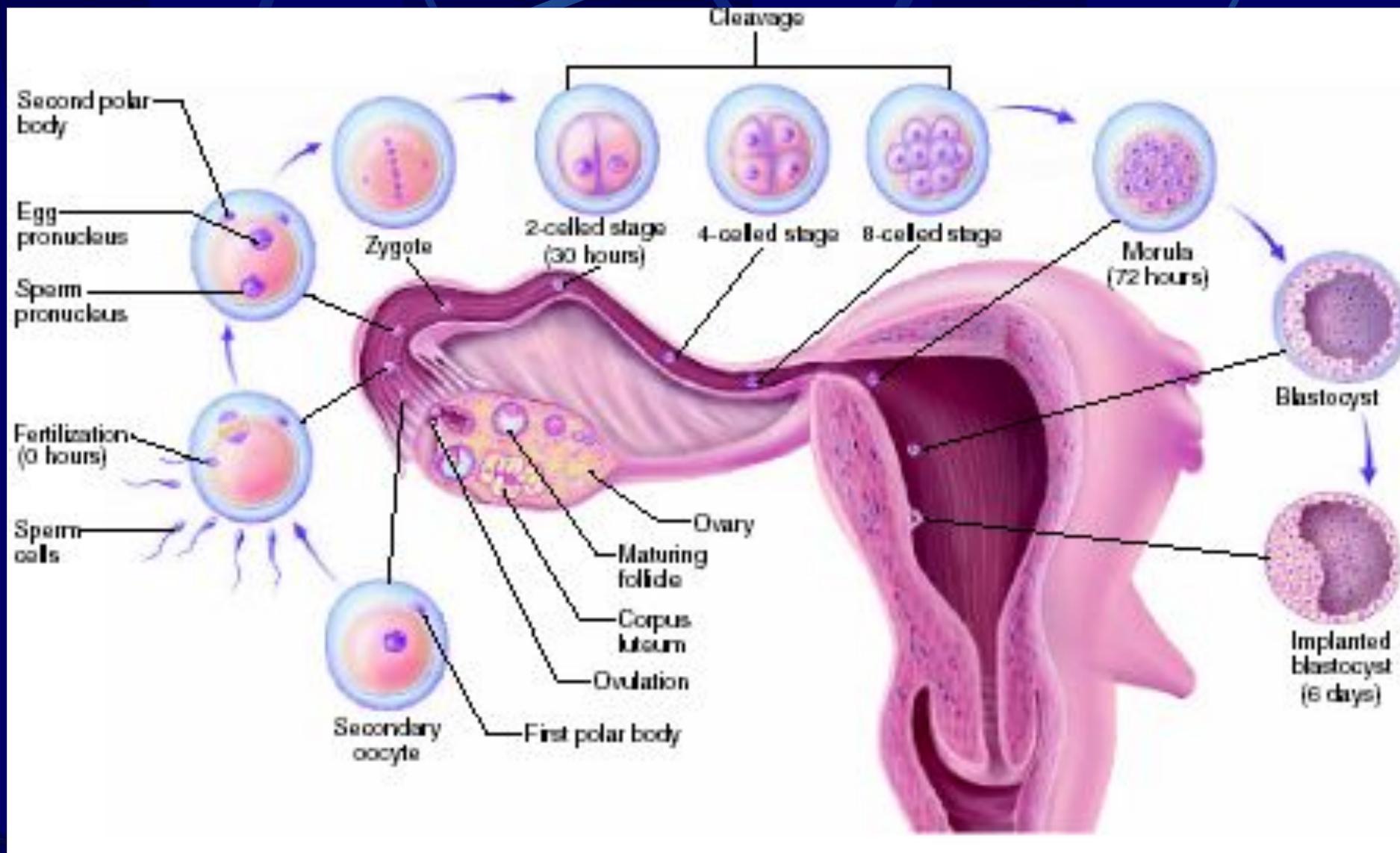


Figure 16.7 Anatomy of ovary and follicle.

As a follicle matures, the oocyte enlarges and is surrounded by layers of follicular cells and fluid. Eventually, ovulation occurs, the mature follicle ruptures, and the secondary oocyte is released. A single follicle actually goes through all stages in one place within the ovary.

Овуляция





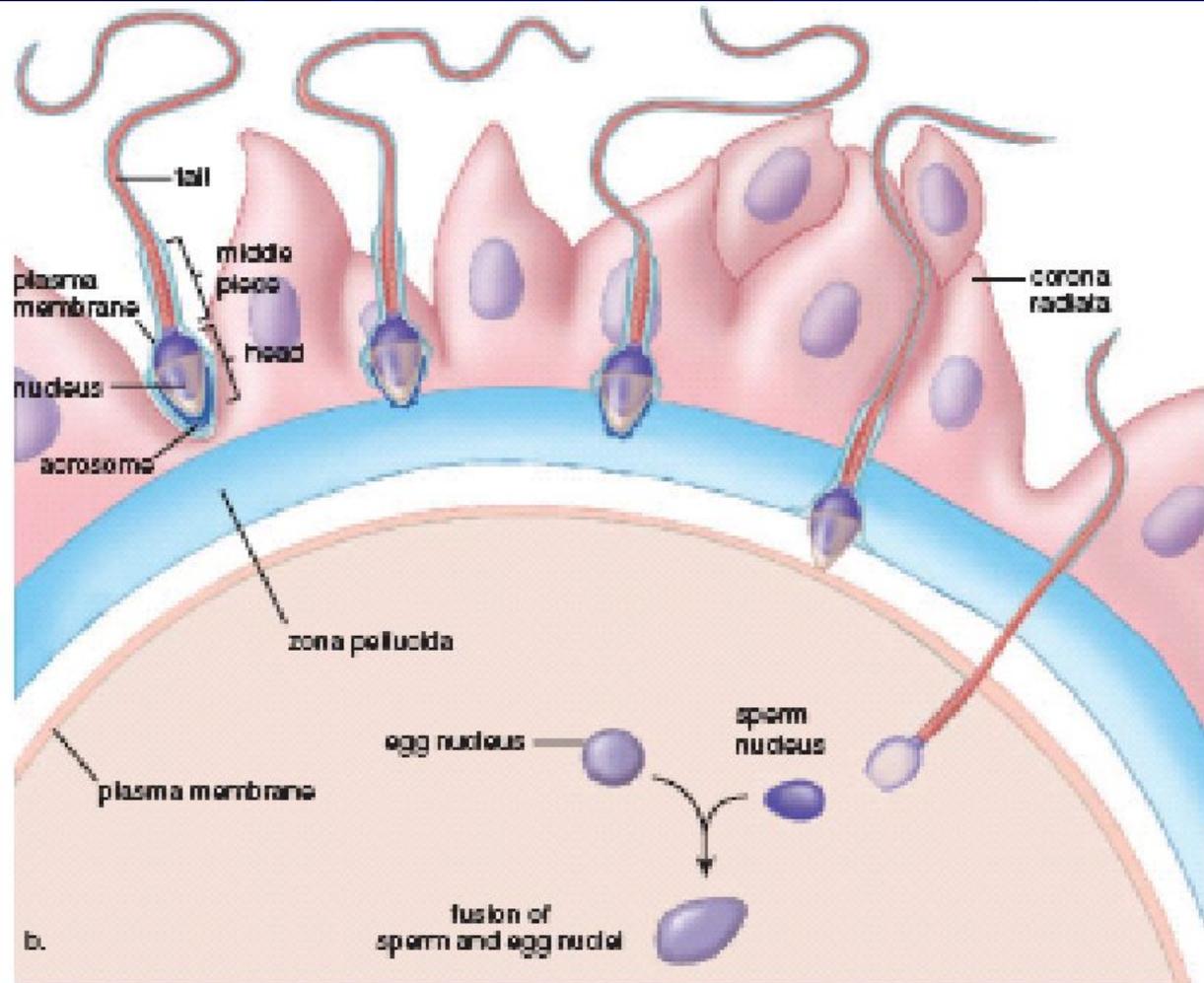
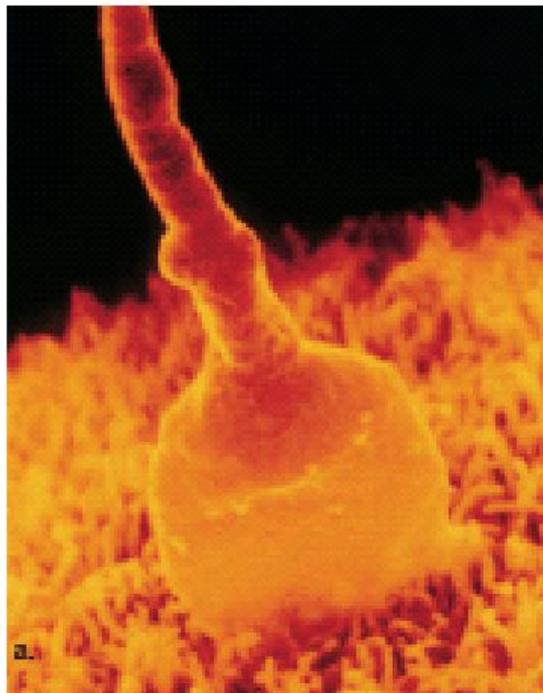


Figure 18.2 Fertilization.

a. During fertilization, a single sperm enters the egg. b. The head of a sperm has a membrane-bounded acrosome filled with enzymes. When released, these enzymes digest a pathway for the sperm through the zona pellucida. After it binds to the plasma membrane of the egg, a sperm enters the egg. When the sperm nucleus fuses with the egg nucleus, fertilization is complete.