SUMMING-UP

1 Asexual reproduction

- Asexual, or vegetative, reproduction occurs by mitosis and produces genetically identical copies of the parents.
- In animals this can occur by:
  - **gemmation** or **budding**;
  - **fission** or **division**;
  - **fragmentation**.
- The advantages of asexual reproduction are represented by the fact that a large number of new individuals can be produce in a very short period of time. The main disadvantage is the fact that individuals are genetically uniform.
- A particular type of reproduction is **parthenogenesis** in which an individual develops from a fertilised egg.

2 Sexual reproduction

- Sexual reproduction is the generation of offspring by means of **fertilisation**, i.e. the union of gametes.
- The female gamete, the **egg cell**, is typically larger than the male gamete, the **spermatozoon**.
- With regard to the female body, fertilisation can take place **externally** or **internally**.
- Sexual reproduction increases the genetic variability of populations.
- In **oviparous animals** development of the embryo takes place outside the mother's body, for example in eggs.
- In **ovovivipary animals** development takes place internally, but without exchange of substances with the mother's body.
- In **viviparous animals** development occurs within the body of the mother and with the exchange of substances.

3 The male reproductive system

- The male reproductive system consists of the testicles that produce sperm, and the **penis**, the organ that is inserted into the body of the female and that deposits the spermatozoa near the female gamete.
- The fluid that contains the spermatozoa and nutrient substances is called **sperm** and is emitted at the time of ejaculation.

4 The female reproductive system

- The female reproductive system consists of: the **vulva**, that is the external genitalia (clitoris and labia) of the vagina, which receives the penis during copulation; the **uterus**, in which the embryo develops; and the ovaries that produce the egg cell.
- The **mammary glands** are considered part of the female reproductive apparatus. They are sweat glands modified so as to be able to produce **milk**, an emulsion containing water, sugar, fat, protein, vitamins and mineral salts.

5 The ovarian and menstrual cycles

- The **ovarian cycle** and the **menstrual cycle** last about a month and include the processes that occur in the ovaries and lead to the production of an egg cell, and the changes in the uterus that make it able to receive the fertilised egg.
- Both these cycles are under the control of hormones secreted by the hypothalamus, by the anterior lobe of the hypophysis (or pituitary gland), and by the ovaries.
- The development of the egg cell takes place within the ovarian follicles and culminates with **ovulation**, during which the oocyte is released into the oviduct.

6 Fertilisation and embryo development

- At the time of fertilisation, the nuclei of the spermatozoa and the egg fuse, giving rise to the **zygote**.
- The zygote goes through several phases leading to the development of the **embryo**: the first is **segmentation**, through which the **morula** is formed and, later, the **blastocyst**. The morula and blastocyst are made of **stem cells**. Then follows the phase known as **gastrulation**.
- At the end of gastrulation it is possible to recognise three **embryonic layers** that give rise to the different organs of the individual.

7 Gene regulation and embryogenesis

- The development of the embryo takes place through a proliferation of cells, through differentiation of the cells, and through morphogenesis, i.e. the organisation of cells into organs and systems.
- These processes are controlled by **development genes** that function through *signal proteins*.
- The process of cellular differentiation occurs through the activation or deactivation of different genes in cells with diverse shape and functions.
- The process of embryonic development also requires that certain groups of cells experience the phenomenon of programmed cell death, called **apoptosis**.

SUMMING-UP

8 Pregnancy and childbirth

- Gestation is the period in which a new human being develops inside the mother's body.
- For *Homo sapiens,* pregnancy lasts about 9 months and ends with the **birth**, that is with the exit of the newborn from the mother's body.
- Starting from the ninth week of gestation, the embryo is called the **foetus**.
- The foetus in the mother's body is surrounded by 4 extra-embryonic membranes and receives nourishment and necessary substances from the mother through the placenta.

9 Reproduction in plants

- Plants reproduce through **asexual reproduction** (or vegetative reproduction), or through **sexual reproduction**.
- The life cycle of plants provides for an alternation of generations in which a **sporophyte** (diploid) is followed by a **gametophyte** (haploid).
- Angiosperms possess a **flower**, which represents its specialised organ for reproduction.

10 Fruit and seed germination

- The **seed** is derived from the fertilised egg cell and represents the heterotrophic phase of the life cycle of a plant. It provides nourishment to the sapling until it is able to perform photosynthesis. The seed contains an embryo, the endosperm, with nutritive functions, and the protective seed coat.
- The seed is contained within the fruit, a structure that is derived from the growth of the flower. The function of the fruit is to facilitate the dissemination and germination of the seed.