Adolescence and Puberty

Definition and Age Range

Adolescence is the period of life when the human body undergoes changes leading to reproductive maturity. It typically begins around 11 years of age and lasts until 18 or 19 years. This phase is also called the teenage years, and individuals in this stage are known as adolescents or teenagers. Girls usually enter adolescence a year or two earlier than boys, and the duration varies among individuals.

Physical Changes

During adolescence, the body experiences a sudden spurt in growth, especially in height. This growth spurt is noticeable and marks the transition from childhood to adulthood. The changes include development of reproductive organs, appearance of secondary sexual characteristics, and changes in body shape and voice.

Puberty

Puberty is the phase within adolescence when the body becomes capable of reproduction. It marks the onset of reproductive maturity and ends when the adolescent reaches full reproductive capability.

Changes at Puberty

Increase in Height

The most noticeable change during puberty is a rapid increase in height. The long bones in the arms and legs elongate, making the person taller. Growth rates vary among individuals, with some experiencing sudden spurts and others growing gradually.

the tallest and who might be the shortest in your class.

Age in Years	% of full height	
	Boys	Girls
8	72%	77%
9	75%	81%
10	78%	84%
11	81%	88%
12	84%	91%
13	88%	95%
14	92%	98%
15	95%	99%
16	98%	99.5%
17	99%	100%

18	100%	100%

Calculation for full height (cm)

$$\frac{\text{Present height (cm)}}{\text{\% of full height at this age (as given in the chart)}} \times 100$$

Example:

A boy is 9 years old and 120 cm tall. At the end of the growth period he is likely to be

$$\frac{120}{75} \times 100 \text{ cm} = 160 \text{ cm tall}$$

Change in Body Shape

Boys develop broader shoulders and wider chests, while girls experience widening below the waist. Boys also develop more prominent muscles. These changes contribute to the distinct body shapes of males and females during adolescence.

Voice Change

In boys, the voice box (larynx) grows larger, causing the voice to deepen. This growth forms a visible protrusion called the Adam's apple. During this time, boys may experience a hoarse or cracking voice temporarily. Girls have smaller larynxes and generally maintain a higher-pitched voice.

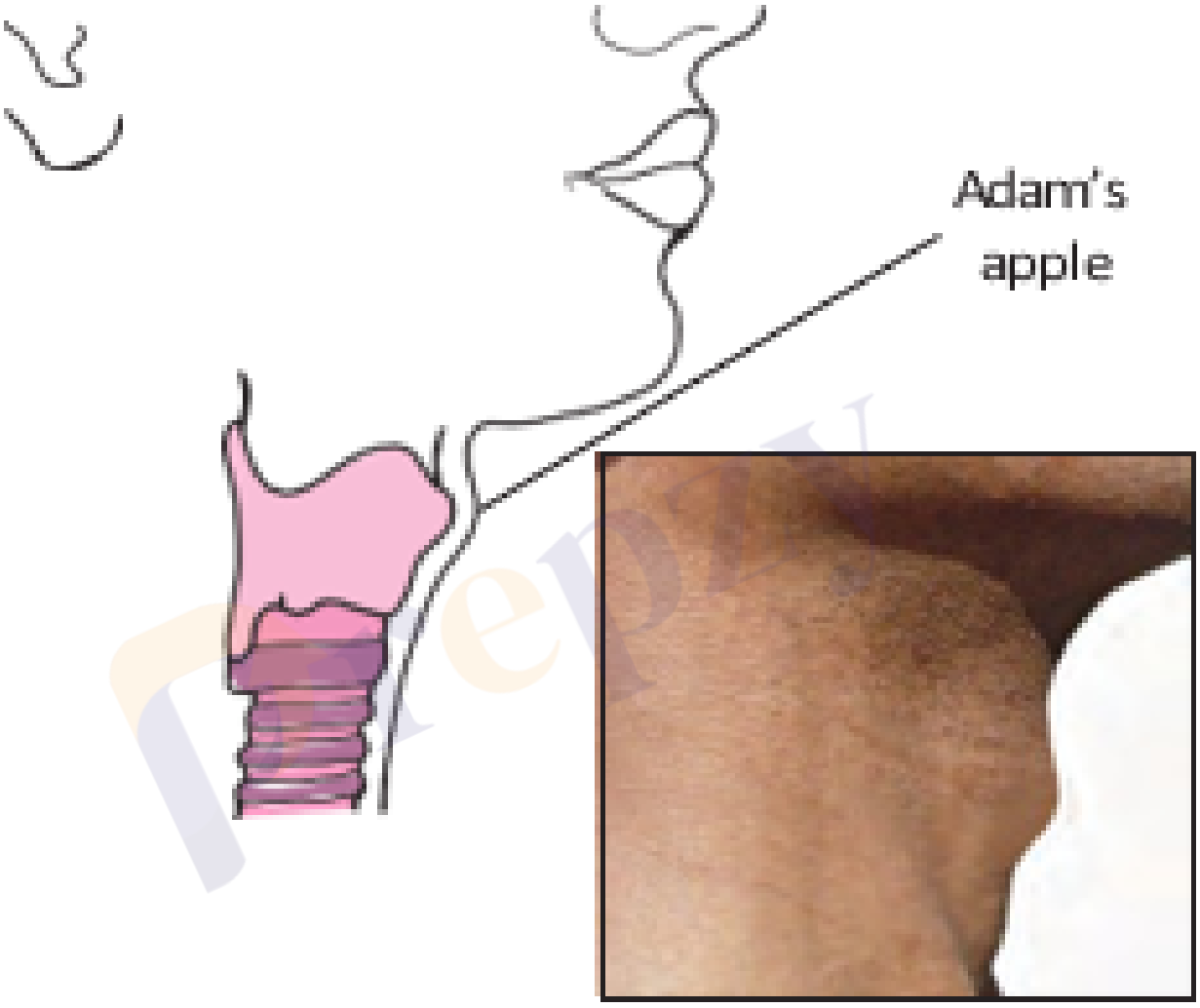

Fig. 7.2 : Adam's apple in a grown up boy

Increased Activity of Sweat and Sebaceous Glands

During puberty, sweat and oil glands become more active, often leading to acne and pimples on the skin.

Development of Sex Organs

Male sex organs such as testes and penis develop fully and begin producing sperms. In females, ovaries enlarge, eggs mature, and mature eggs are released.

Mental and Emotional Maturity

Adolescence also involves intellectual growth and emotional changes. Adolescents become more independent and self-conscious, with increased capacity for learning and thinking.

Solved Examples

Example: A 9-year-old boy is 120 cm tall. Using the growth chart, estimate his probable full adult height.

Solution: At age 9, boys have reached approximately 75% of their full height.

Using the formula: Full height = (Present height × 100) / Percentage of full height at this age

Full height = (120 × 100) / 75 = 160 cm

Therefore, the boy is likely to grow to 160 cm tall.

Practice Set

- **Level 1 (Easy):** What is adolescence and at what age does it typically begin?
- **Level 2 (Moderate):** Explain why boys develop a deeper voice during puberty.
- **Level 3 (Challenging):** Using the growth chart, estimate the full height of a 12-year-old girl who is currently 140 cm tall.

Answer Key

- **Level 1:** Adolescence is the period of life when the body undergoes changes leading to reproductive maturity, typically beginning around 11 years of age.
- **Level 2:** Boys develop a deeper voice during puberty because their voice box (larynx) grows larger, and the thyroid cartilage forms the Adam's apple, causing the voice to deepen.
- **Level 3:** At age 12, girls have reached about 92% of their full height. Using the formula: Full height = (140 × 100) / 92 ≈ 152.17 cm.

Secondary Sexual Characters

Definition

Secondary sexual characters are features that distinguish males and females but are not directly involved in reproduction. These develop during puberty under the influence of sex hormones.

Examples in Males

Boys develop facial hair such as moustaches and beards, hair on the chest, and hair under the arms and pubic region. Their shoulders broaden and muscles develop prominently.

Examples in Females

Girls develop breasts, and hair grows under the arms and in the pubic region. The region below the waist becomes wider.

Role of Hormones

Hormones secreted by endocrine glands control these changes. Testosterone is the male hormone produced by testes, and estrogen is the female hormone produced by ovaries. The pituitary gland regulates the production of these hormones.

Solved Examples

Example: Describe the role of the pituitary gland in puberty.

Solution: The pituitary gland secretes hormones that stimulate the testes and ovaries to produce sex hormones (testosterone and estrogen). These hormones cause the development of secondary sexual characters and reproductive maturity.

Practice Set

- **Level 1 (Easy):** What are secondary sexual characters?
- **Level 2 (Moderate):** Name the male and female sex hormones and their source glands.
- **Level 3 (Challenging):** Explain how the pituitary gland controls the onset of puberty.

Answer Key

- **Level 1:** Secondary sexual characters are features that distinguish males and females but are not directly involved in reproduction.
- **Level 2:** Testosterone is the male sex hormone produced by testes; estrogen is the female sex hormone produced by ovaries.
- **Level 3:** The pituitary gland secretes hormones that stimulate the testes and ovaries to produce sex hormones, which then cause the physical changes of puberty.

Reproductive Phase

Duration in Males and Females

In males, the reproductive phase lasts longer as testes produce sperms continuously after puberty. In females, it begins at puberty (10-12 years) and lasts until about 45-50 years of age.

Menstrual Cycle

In females, one ovum matures and is released approximately every 28-30 days. The uterine wall thickens to receive a fertilized egg. If fertilization does not occur, the lining and egg are shed as menstruation. The first menstrual flow is called menarche, and the cessation of menstruation is called menopause.

Hormonal Control

The menstrual cycle is regulated by hormones that control egg maturation, release, and uterine lining changes.

Solved Examples

Example: Define menarche and menopause.

Solution: Menarche is the first menstrual flow marking the start of reproductive capability. Menopause is the cessation of menstruation, marking the end of the reproductive phase.

Practice Set

- **Level 1 (Easy):** What is the reproductive phase in humans?
- **Level 2 (Moderate):** Describe the menstrual cycle and its significance.

- **Level 3 (Challenging):** Explain why the reproductive phase lasts longer in males than in females.

Answer Key

- **Level 1:** The reproductive phase is the period when humans are capable of reproduction, starting at puberty.
- **Level 2:** The menstrual cycle involves maturation and release of an egg and preparation of the uterus for pregnancy; if fertilization does not occur, menstruation happens.
- **Level 3:** Males produce sperms continuously after puberty, while females have a limited number of eggs and reproductive years.

Sex Determination

Chromosomes and Sex

Humans have 23 pairs of chromosomes in each cell, including one pair of sex chromosomes: X and Y. Females have two X chromosomes (XX), and males have one X and one Y chromosome (XY).

Role of Gametes

Eggs always carry an X chromosome. Sperms carry either an X or a Y chromosome. The combination of sperm and egg chromosomes determines the sex of the baby.

Determination Process

If a sperm carrying an X chromosome fertilizes the egg, the zygote is XX (female). If a sperm carrying a Y chromosome fertilizes the egg, the zygote is XY (male).

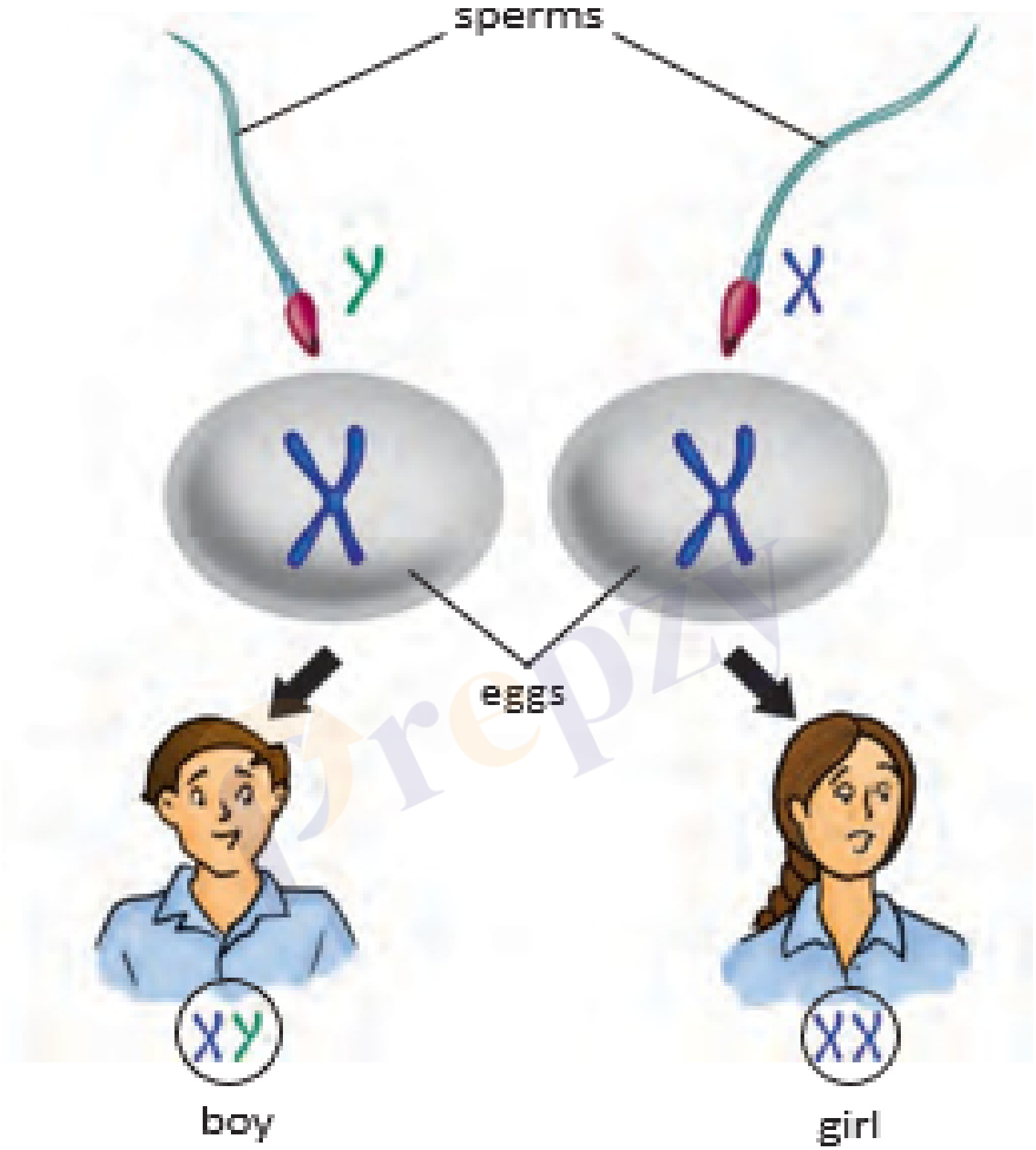

Fig. 7.4 : Sex determination in humans

Solved Examples

Example: What determines the sex of a baby?

Solution: The sex of a baby is determined by the sperm chromosome that fertilizes the egg. An X chromosome results in a female (XX), and a Y chromosome results in a male (XY).

Practice Set

- **Level 1 (Easy):** How many pairs of chromosomes do humans have?
- **Level 2 (Moderate):** What are the sex chromosomes in males and females?
- **Level 3 (Challenging):** Explain how the sperm determines the sex of the baby.

Answer Key

- **Level 1:** Humans have 23 pairs of chromosomes.
- **Level 2:** Females have XX chromosomes; males have XY chromosomes.
- **Level 3:** Sperms carry either X or Y chromosome; fertilization with X sperm results in a female, with Y sperm results in a male.

Hormones and Endocrine Glands

Endocrine System

Endocrine glands release hormones directly into the bloodstream. These hormones regulate various body functions including growth, metabolism, and reproduction.

Major Endocrine Glands

The major glands include the pituitary, thyroid, adrenal glands, pancreas, ovaries (in females), and testes (in males).

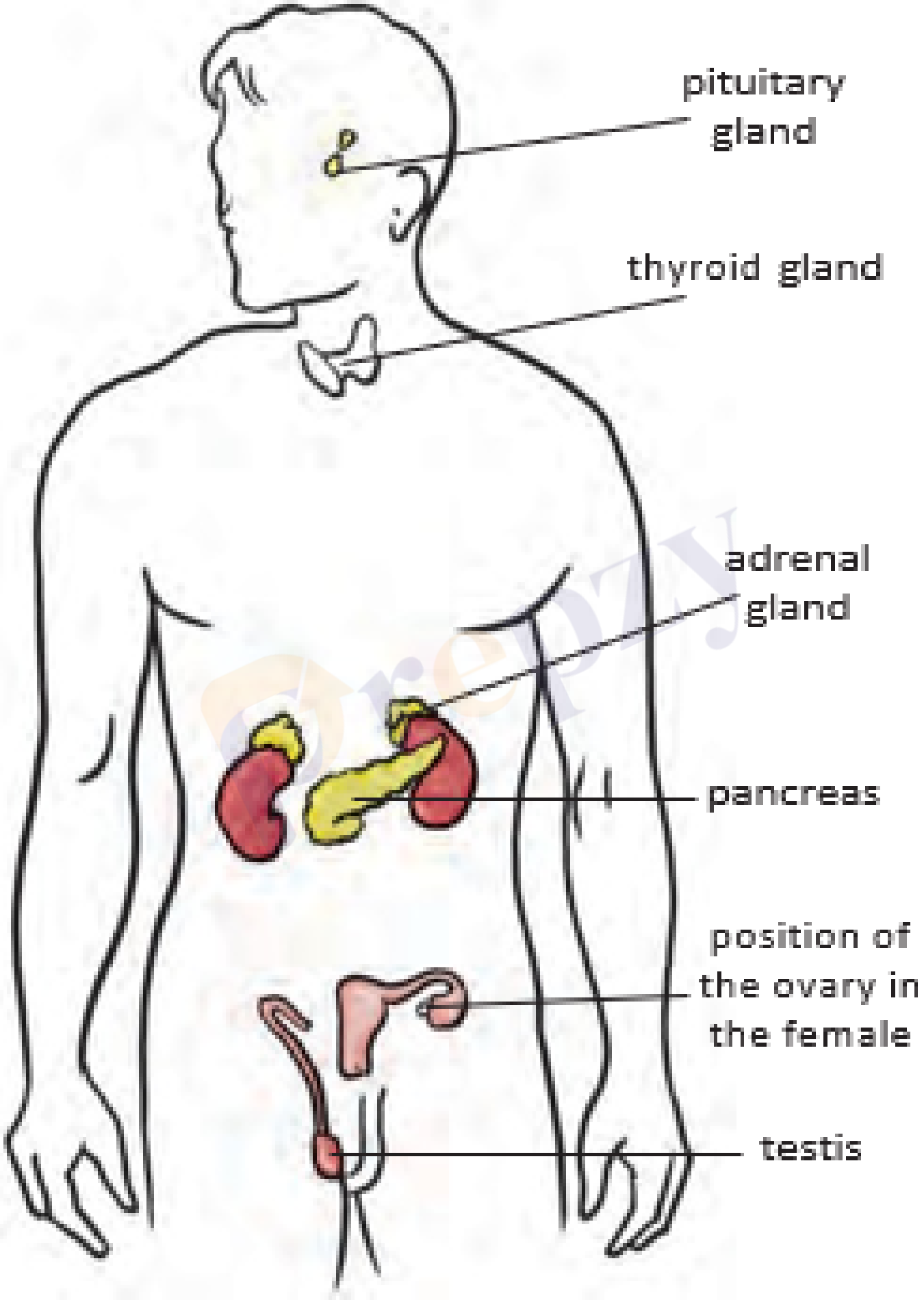

Fig. 7.5 : Position of endocrine glands in the human body

Functions of Hormones

Each gland produces specific hormones: pituitary controls other glands and growth; thyroid regulates metabolism; adrenal glands manage stress response; pancreas controls blood sugar; ovaries and testes produce sex hormones.

Disorders

Insufficient hormone production can cause diseases such as goitre (thyroid) and diabetes (pancreas).

Solved Examples

Example: Name the hormone produced by the pancreas and its function.

Solution: The pancreas produces insulin, which regulates blood sugar levels.

Practice Set

- **Level 1 (Easy):** What are hormones?
- **Level 2 (Moderate):** List three endocrine glands and their hormones.
- **Level 3 (Challenging):** Explain the role of the pituitary gland in hormone regulation.

Answer Key

- **Level 1:** Hormones are chemical substances secreted by endocrine glands into the bloodstream to regulate body functions.
- **Level 2:** Pituitary (growth hormone), thyroid (thyroxine), pancreas (insulin).

- **Level 3:** The pituitary gland secretes hormones that control other endocrine glands and regulate growth and development.

Reproductive Health

Importance of Nutrition

Adolescents require a balanced diet rich in proteins, carbohydrates, fats, vitamins, and minerals to support rapid growth and development. Iron-rich foods help build blood.

meat

vegetables

milk and eggs

fruits

grains

Fig. 7.6 *: Nutritious items of food*

Personal Hygiene

Maintaining cleanliness is essential, especially during adolescence due to increased sweat gland activity. Girls should practice special hygiene during menstruation.

Physical Exercise

Regular exercise and outdoor activities help maintain fitness and health.

Say No to Drugs

Adolescents should avoid drugs as they are addictive and harmful. Awareness about diseases like AIDS, transmitted through unsafe practices, is important.

Myths and Taboos

Many myths about adolescence and reproduction exist, such as blaming the mother for the sex of the child or restrictions during menstruation. These are scientifically incorrect and should be discarded.

Adolescent Pregnancy

Early marriage and pregnancy can cause health and social problems. The legal age for marriage is 18 for girls and 21 for boys to ensure readiness for parenthood.

Solved Examples

Example: Why is a balanced diet important during adolescence?

Solution: A balanced diet provides essential nutrients needed for rapid growth, development, and overall health during adolescence.

Practice Set

- **Level 1 (Easy):** What is a balanced diet?
- **Level 2 (Moderate):** Why is personal hygiene important during adolescence?
- **Level 3 (Challenging):** Discuss the consequences of adolescent pregnancy.

Answer Key

- **Level 1:** A balanced diet includes proteins, carbohydrates, fats, vitamins, and minerals in proper proportions.
- **Level 2:** Personal hygiene prevents infections and maintains health, especially with increased sweat gland activity.
- **Level 3:** Adolescent pregnancy can cause health risks for mother and child, limit education and employment opportunities, and cause mental stress.

Quick Reference Table

Common Mistakes and Misconceptions

Glossary