

## Section 1: Hormones

### • What are hormones?

Hormones are chemical messengers which are secreted into the blood by ductless glands called endocrine glands. These hormones travel around the body where they stimulate target cells and tissues to respond. For example, growth hormone is produced by a gland beneath the brain called the pituitary gland. Growth hormone stimulates cells all over the body to divide and grow. Insulin is another hormone which instructs the liver and muscles to take up and store glucose from the blood. It is produced by a gland called the pancreas. There are lots of different hormones acting in the body, some have wide ranging effects like growth hormone, others are more specific like insulin. Some act very quickly like adrenaline, whereas others act over longer time periods, like testosterone and oestrogen.



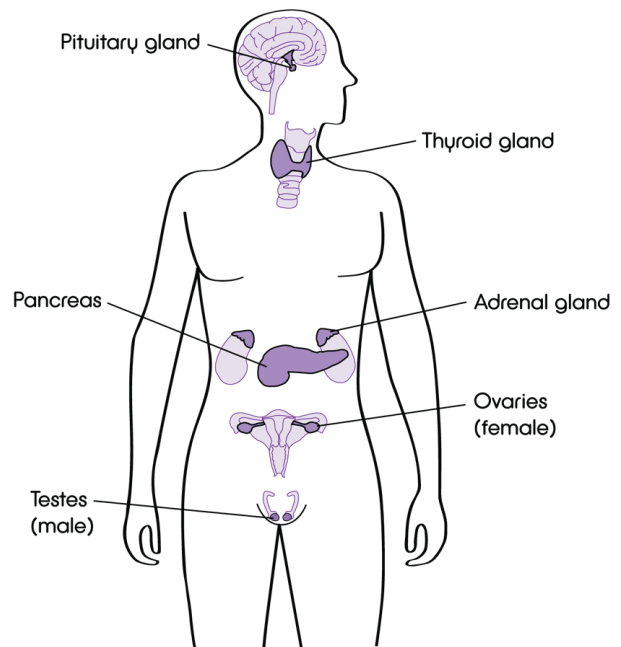
Growth hormone is produced by the pituitary gland which is located beneath the brain

## DIAGRAM 01:



### Major Endocrine Organs

BIOLOGY • BEING HUMAN • HORMONES



### • Suggested Film

– Introduction to Hormones

### Extension Question

Q1. How does the hormone system compare to the nervous system?

Because the hormone system involves chemicals travelling in the bloodstream it doesn't act as quickly as the nervous system. Nervous reactions can occur in fractions of a second, whereas hormones may take minutes or longer to take effect. Hormones, however, tend to have longer lasting effects in the body than nervous responses.

• Why do we need hormones?

Hormones help us respond to our environment and coordinate many of our bodily functions. Some, like adrenaline and cortisol, help the body to prepare and respond to stressful situations. Others, like the sex hormones, control the development of our bodies during puberty.

• Suggested Film

– Introduction to Hormones

Extension Question

Q2. What happens if we produce too much or too little of a hormone?

Producing the incorrect amount of a hormone can have dramatic effects on bodily function and in some cases lead to death. Diabetics produce insufficient insulin and so are not able to control the level of sugar in their blood unless they inject themselves with the hormone. Some of the tallest people who ever lived reached nearly 9 feet (2.7m) tall because they had a condition in which they overproduced growth hormone.

• How do hormones work?

Most hormones are proteins, though a few are steroids. They have specific structures and so can only bind to and stimulate those cells that have complementary receptors. Once a hormone has bound to a target cell it will cause the cell to respond in some way. For example, it might cause the cell to divide or to produce another hormone.

• Suggested Film

– Introduction to Hormones

Extension Questions

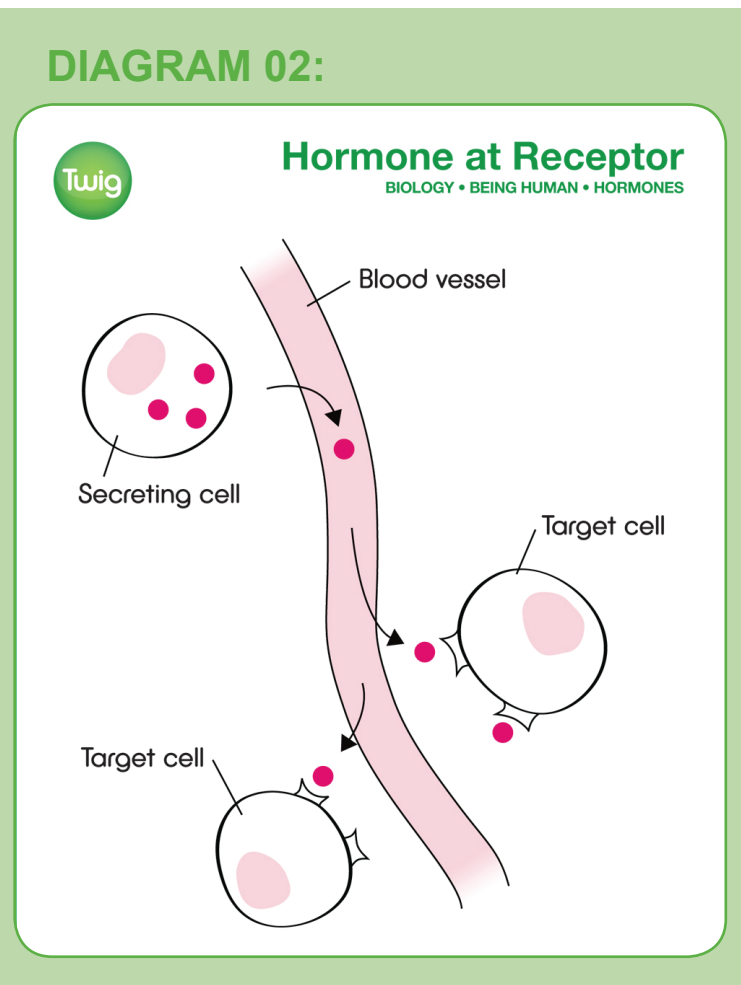
Q3. What are the steroid hormones?

The steroid hormones include cortisol, testosterone, oestrogen and progesterone.

Q4. What are anabolic steroids?

Anabolic steroids are chemicals which mimic the action of testosterone. Being chemically similar to testosterone they can bind to testosterone receptors on cells. As a result they promote greater development of the male secondary sexual characteristics, and in particular they enhance muscle growth. This is why they are often used by body builders and athletes as performance enhancing drugs.

DIAGRAM 02:



## Section 2: Types of Hormones

### • What does adrenaline do?

Adrenaline is a fast acting hormone produced by the adrenal glands, which are found just above the kidneys. Adrenaline is released into the blood in response to threats. It causes a wide range of effects, known as the 'fight or flight response', which are designed to prepare the body to deal with the threat, perhaps by fighting or fleeing. The heart and breathing rates speed up, the pupils dilate, sweat is secreted onto the skin, and blood sugar levels rise.

#### • Suggested Film

– **Cortisol and Chronic Stress**

#### Extension Questions

**Q5. What are the benefits of the responses by the body in a fight or flight situation?**

Increased breathing rate provides the blood and thus the cells with more oxygen for respiration. Increased heart rate leads to improved transportation rates of oxygen and glucose around the body. The break down of glycogen to glucose causes blood sugar to rise – again allowing for increased respiration. Sweating allows the body to cool rapidly and dilated pupils allow more light and visual information into the eye.

**Q6. What happens to adrenaline levels once a threat has passed?**

Hormone levels need to fall once they are no longer needed. Typically, the liver breaks down excess hormones, though this occurs at different rates depending on the hormone type. Adrenaline is typically broken down quite quickly, allowing the body to return to its pre-stressed state.

### • What does insulin do?

Insulin lowers blood sugar levels. After a meal blood sugar rises and this is detected by the pancreas, which responds by secreting insulin. The insulin triggers liver and muscle cells to take up the glucose and store it as a substance called glycogen. This means that blood sugar levels don't get too high.

When blood sugar levels start to fall, for example during exercise or between meals, the glycogen is broken down back to glucose, which is released into the blood so that blood sugar levels don't get too low.

#### Extension Question

**Q7. Why are more people becoming diabetic?**

Poor diet, including too much sugar, and higher obesity rates are linked to greater rates of type 2 diabetes. These two factors place increased demands on the pancreas, which simply can't cope over the years. As a result, type 2 diabetes in the young is being diagnosed much more frequently than it was two decades ago.



**A poor diet can increase the risk of developing type 2 diabetes**







#### • Suggested Film

– **Insulin and Diabetes**

### DIAGRAM 03:

### Major Hormones, Glands and Target Tissues

BIOLOGY • BEING HUMAN • HORMONES

Gland	Hormone	Example of target tissue
Adrenal	Adrenaline	Heart 
Pancreas	Insulin	Liver 
Ovaries 	Oestrogen	Uterus
Testes 	Testosterone	Muscles 
Thyroid	Thyroxine	Most cells
Pituitary 	Growth hormone	Most cells

#### • Suggested Activity

- Ask the students to produce a poster about diabetes, showing its causes, symptoms and treatment



Diabetics test their blood regularly to monitor sugar levels

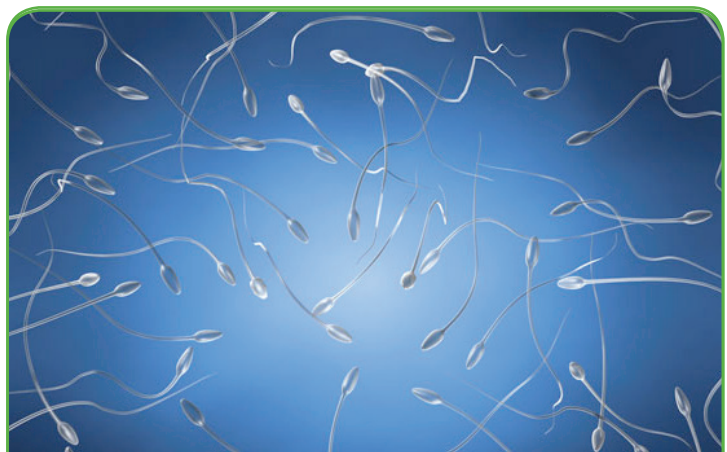
### Section 3: Puberty

#### • What is puberty?

Puberty is the phase in the human life cycle when the child's body develops into the adult body, which is capable of reproduction. It happens in response to the sex hormones – testosterone in men and oestrogen in women. Although the onset of puberty varies between individuals, girls generally begin puberty earlier than boys. Girls show the first signs of puberty at about 11 years and boys at about 13 years.

#### • Suggested Films

- Introduction to Puberty
- Why Do Teens Get Spots?
- Melatonin and Sleep
- The Developing Brain: Teenage Brains



Hormones sometimes produce mood swings in teenagers

### • What are the effects of testosterone on the male body?

Testosterone is the male sex hormone. It is produced by the testes from puberty until death. At puberty testosterone levels rise and cause the development of the male secondary sexual characteristics. The voice deepens, the penis grows, pubic hair appears and the boy slowly turns to man. In addition, sperm start to be produced.

#### Extension Question

Q8. What causes the voice to 'break'?

As a boy goes through puberty his voice box (the larynx) widens and thickens in response to the action of testosterone. The vocal cords inside the larynx lengthen and thicken so his voice gets deeper. During these changes a boy can't always control his vocal cords very well, so his voice can change pitch very dramatically at times.

#### • Suggested Film

– Puberty in Boys

### • What are the effects of oestrogen on the female body?

Oestrogen is the female sex hormone and it is produced by the ovaries. It causes the development of the secondary sexual characteristics in women. The breasts develop, pubic hair grows and the female menstrual cycle begins. Eggs start to be produced every month.

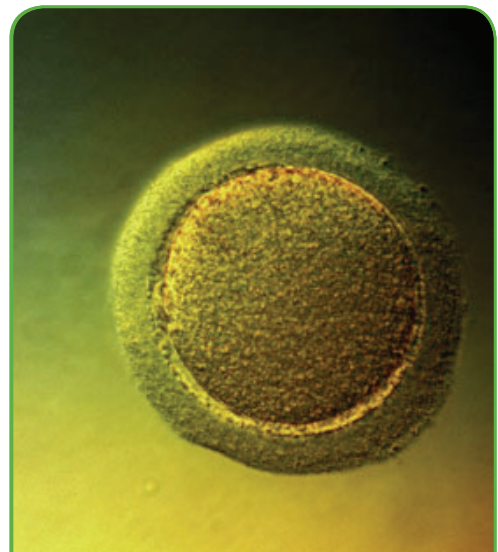
#### Extension Question

Q9. What is menstruation?

Menstruation is the shedding of the lining of the female uterus – also known as a 'period'. This lining builds up during the first half of the menstrual cycle in preparation for a possible pregnancy. If the woman does not become pregnant the lining is shed at the end of the monthly cycle.

#### • Suggested Film

– Puberty in Girls



In girls, a signal from the pituitary gland causes an egg to be released every month

## • Quizzes

## Introduction to Hormones

## Basic

• How do hormones travel around the body?

- A – in glands
- B – in the nerves
- C – in the blood
- D – by diffusion

• Which of the following is an example of an endocrine organ?

- A – brain
- B – kidneys
- C – adrenals
- D – heart

• Which of the following is an example of a hormone?

- A – testosterone
- B – haemoglobin
- C – amylase
- D – bile

## Advanced

• How do hormones travel around the body?

- A – in glands
- B – in the nerves
- C – in the blood
- D – by diffusion

• Which glands secrete hormones?

- A – exocrine glands
- B – sebaceous glands
- C – secretory glands
- D – endocrine glands

• Which hormone acts quickly in the body?

- A – adrenaline
- B – oestrogen
- C – growth hormones
- D – testosterone



### Introduction to Puberty

#### Basic

• What is puberty?

- A – the type of hair growing in the armpits
- B – a period of growing up
- C – the phase between childhood and adulthood
- D – the phase of development of the sexual organs to allow for reproduction

• What is the name of the male sex hormone?

- A – oestrogen
- B – adrenaline
- C – testosterone
- D – insulin

• What is the name of the female sex hormone?

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- B – adrenaline
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- D – insulin

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• What is the region of the brain which controls puberty?

- A – cerebrum
- B – cerebellum
- C – ovary
- D – hypothalamus

• What is the name of the hormone that initiates puberty?

- A – oestrogen
- B – testosterone
- C – gonadotrophin-releasing hormone
- D – follicle-stimulating hormone

• What are secondary sexual characteristics?

- A – the sex organs you are born with
- B – the bodily features which develop during puberty
- C – the behaviours of an adolescent
- D – whether a person is male or female

• Answers

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