

# 16.4.1 The reproductive systems, the gametes and the placenta

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_ **Total: 31 marks**

**KEY WORDS** sperm 精子 • placenta 胎盘 • fetus 胎儿 • fertilisation 受精 • embryo 胚胎

## Objective

Sheet 16.4 covered the **placenta** 胎盘 and one sperm question. This sheet is the rest of 16.4: naming every part of the male and female reproductive systems **with its function**, the **adaptive features** 适应特征 of the two **gametes** 配子 and how they compare, what happens between **fertilisation** 受精 and **implantation** 着床, and exactly what crosses the placenta. Nearly every mark here is a named part paired with what it does. This sheet covers syllabus 16.4.

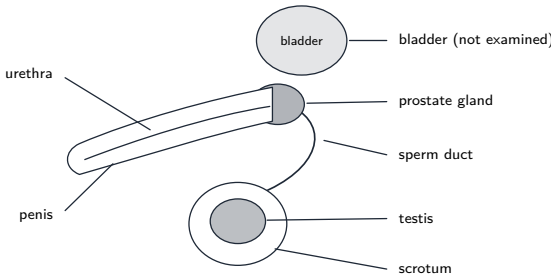
**You must be able to:**

- identify, and state the functions of, the testes, **scrotum** 阴囊, **sperm ducts** 输精管, **prostate gland** 前列腺, **urethra** 尿道 and penis
- identify, and state the functions of, the ovaries, **oviducts** 输卵管, **uterus** 子宫, **cervix** 子宫颈 and vagina
- describe fertilisation as the fusion of the **nuclei** 细胞核 of a sperm and an egg cell
- explain the adaptive features of sperm: the **flagellum** 鞭毛, the **mitochondria** 线粒体 and the enzymes in the **acrosome** 顶体
- explain the adaptive features of egg cells: the energy stores and the **jelly coat** 卵膜 that changes at fertilisation
- compare male and female gametes by size, structure, **motility** 运动能力 and numbers
- state that the **zygote** 受精卵 forms an **embryo** 胚胎, a ball of cells that implants into the lining of the uterus
- identify, and state the functions of, the **umbilical cord** 脐带, placenta, **amniotic sac** 羊膜囊 and **amniotic fluid** 羊水
- describe how the placenta and umbilical cord exchange dissolved nutrients, gases and excretory products, and state that some **pathogens** 病原体 and **toxins** 毒素 can cross the placenta

## 1 Worked examples

Study these first. Each one shows a **method** that a question later on this sheet needs.

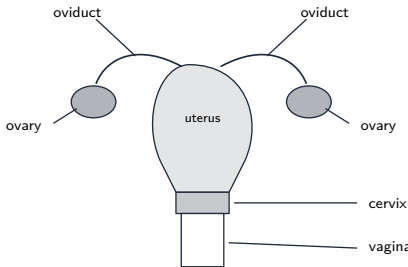
### ■ The male system: six parts, six functions



Each part has *one* function to learn: **testis** makes sperm and testosterone; **scrotum** holds the testes outside the body, slightly cooler; **sperm duct** carries sperm; **prostate gland** adds fluid; **urethra** carries sperm (and urine) out; **penis** places sperm inside the vagina.

| part                  | function                                                                             |
|-----------------------|--------------------------------------------------------------------------------------|
| <b>testis</b>         | makes sperm, and the hormone <b>testosterone</b> 睾酮                                  |
| <b>scrotum</b>        | holds the testes outside the body, where it is slightly cooler than body temperature |
| <b>sperm duct</b>     | carries sperm from the testis towards the urethra                                    |
| <b>prostate gland</b> | adds fluid to the sperm, which the sperm swim in                                     |
| <b>urethra</b>        | carries sperm (and, at other times, urine) out of the body                           |
| <b>penis</b>          | becomes firm and places the sperm inside the vagina                                  |

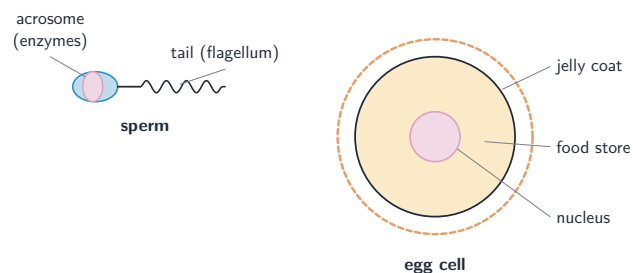
### ■ The female system: five parts, five functions



**Ovary** releases an egg cell each month; **oviduct** carries it, and is where **fertilisation** happens; **uterus** is where the embryo implants and the fetus develops; **cervix** is the ring of muscle at its neck; **vagina** receives the sperm and is the birth canal.

| part           | function                                                                                         |
|----------------|--------------------------------------------------------------------------------------------------|
| <b>ovary</b>   | makes egg cells and releases one about once a month                                              |
| <b>oviduct</b> | carries the egg cell towards the uterus; <b>fertilisation happens here</b>                       |
| <b>uterus</b>  | where the embryo implants and the fetus develops; its muscular wall pushes the baby out at birth |
| <b>cervix</b>  | a ring of muscle at the neck of the uterus, which holds the fetus in and widens at birth         |
| <b>vagina</b>  | receives the sperm, and is the birth canal                                                       |

### ■ The gametes, and why each is shaped as it is



sperm: small, millions, swims | egg: large, few, carried

**Fertilisation is the fusion of the nucleus of a sperm with the nucleus of an egg cell.** Two haploid nuclei join, giving a diploid zygote. Say *nuclei*, not “the sperm joins the egg”.

| feature of a sperm                           | what it does                                                        |
|----------------------------------------------|---------------------------------------------------------------------|
| <b>flagellum</b> (tail)                      | beats so the sperm can <b>swim</b> to the egg cell                  |
| many <b>mitochondria</b> in the middle piece | release the <b>energy</b> for swimming, by respiration              |
| enzymes in the <b>acrosome</b>               | <b>digest</b> a way through the jelly coat so the nucleus can enter |

| feature of an egg cell                | what it does                                                               |
|---------------------------------------|----------------------------------------------------------------------------|
| <b>energy stores</b> in the cytoplasm | feed the embryo until it implants and the placenta takes over              |
| the <b>jelly coat</b>                 | <b>changes</b> the instant one sperm enters, so no second sperm can get in |

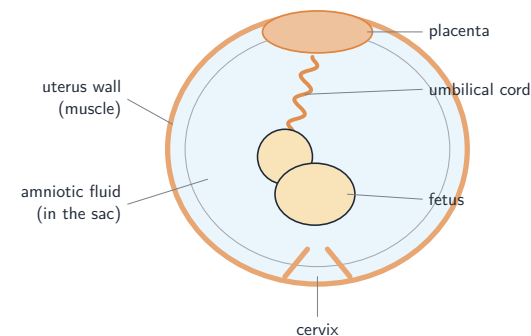
The **comparison question** asks for four things, so answer in four pairs:

|           | sperm                             | egg cell                                                   |
|-----------|-----------------------------------|------------------------------------------------------------|
| size      | much <b>smaller</b>               | much <b>larger</b>                                         |
| structure | a flagellum and many mitochondria | energy stores and a jelly coat, no flagellum               |
| motility  | <b>moves</b> itself               | <b>cannot move</b> itself; it is carried along the oviduct |
| numbers   | <b>millions</b> released at once  | usually <b>one</b> a month                                 |

### ■ From zygote to implantation

1. The sperm nucleus fuses with the egg nucleus in the **oviduct**, giving a **zygote**.
2. The zygote divides by **mitosis** 有丝分裂 into a **ball of cells**, the **embryo**, as it travels down the oviduct.
3. The embryo **implants** into the **lining of the uterus**, and the placenta begins to develop.

### ■ The placenta: what crosses, and what does not



| structure             | function                                                              |
|-----------------------|-----------------------------------------------------------------------|
| <b>placenta</b>       | the exchange surface between the mother's blood and the fetus's blood |
| <b>umbilical cord</b> | carries the fetus's blood to and from the placenta                    |
| <b>amniotic sac</b>   | encloses the fetus and holds the amniotic fluid                       |
| <b>amniotic fluid</b> | <b>protects</b> the fetus from knocks and supports its weight         |

- **From mother to fetus:** dissolved **nutrients** (glucose, amino acids) and **oxygen**.
- **From fetus to mother:** **carbon dioxide** and **urea** 尿素 – the excretory products.

- Everything crosses by **diffusion** 扩散, so the placenta has a **large surface area** and a **thin barrier**, which gives a short diffusion distance.
- The two blood supplies stay **separate**. They come very close but never mix.
- $\triangle$  Some **pathogens** and **toxins** can cross the placenta as well – for example nicotine and carbon monoxide from smoking, and alcohol.

## 2 Practice

Now use the methods above.

**2.1** Name the part of the male reproductive system that makes sperm, and the part that adds fluid to them. [2]

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**2.2** Name the part of the female reproductive system where fertilisation happens, and the part where the embryo implants. [2]

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**2.3** Describe what happens at fertilisation. [2]

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**2.4** State the function of the jelly coat of an egg cell, and explain why it changes at fertilisation. [3]

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**2.5** State **two** ways, other than size, in which an egg cell differs from a sperm cell. [2]

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**2.6** Describe what happens to the zygote between fertilisation and implantation. [3]

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## 3 Exam-style questions

**3.1** Which row correctly compares a human egg cell with a human sperm cell? [1]

|          | size of egg | which gamete moves itself | number released       |
|----------|-------------|---------------------------|-----------------------|
| <b>A</b> | larger      | the egg                   | more eggs than sperm  |
| <b>B</b> | larger      | the sperm                 | fewer eggs than sperm |
| <b>C</b> | smaller     | the sperm                 | more eggs than sperm  |
| <b>D</b> | larger      | the sperm                 | more eggs than sperm  |

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**3.2** A sperm cell and an egg cell are both adapted to their functions.

(a) Explain how the **acrosome**, the **mitochondria** and the **flagellum** each adapt a sperm cell to its function. [3]

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(b) Explain how the **energy stores** and the **jelly coat** each adapt an egg cell to its function. [3]

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**3.3** A fetus develops in its mother's uterus, joined to the placenta.

(a) Name the structure that joins the fetus to the placenta, and state the function of the amniotic fluid. [2]

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(b) Name **two** substances that pass from the mother's blood to the fetus's blood, and **one** that passes from the fetus's blood to the mother's. [3]

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(c) The placenta has a large surface area and a very thin barrier between the two blood supplies. Explain why both of these features are needed. [2]

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(d) A pregnant woman smokes. Explain how this can affect her fetus. [3]

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## Solutions

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Each answer shows the steps, then the **result**.

### 2.1

- the **testis** makes sperm
- the **prostate gland** adds fluid to them

### 2.2

- fertilisation happens in the **oviduct**
- the embryo implants in the **uterus**, in its lining

### 2.3

- the **nucleus** of a sperm fuses with the **nucleus** of an egg cell
- the two haploid nuclei join, giving a **diploid zygote**

### 2.4

- the jelly coat surrounds and **protects** the egg cell
- as soon as one sperm has entered, the coat **changes**
- so that **no other sperm can get in**, which keeps the zygote diploid

### 2.5

- any **two** of: the sperm can **move itself** with its flagellum, while the egg cell cannot; **millions** of sperm are released at once, but usually only **one** egg a month; the egg cell has **energy stores** and a **jelly coat**, which the sperm does not

### 2.6

- the zygote divides by **mitosis**
- forming a **ball of cells**, the embryo, as it travels down the oviduct
- the embryo then **implants** into the lining of the uterus

### 3.1 B

- the egg cell is much larger, the sperm is the gamete that swims, and far more sperm are released than eggs
- **A** has the egg swimming; **C** has the sizes the wrong way round; **D** has the numbers the wrong way round

### 3.2

(a)

- the **acrosome** contains enzymes that **digest** a way through the jelly coat, so the sperm nucleus can enter
- the **mitochondria** release **energy** by respiration, for swimming
- the **flagellum** beats, so the sperm can **swim** to the egg cell

(b)

- the **energy stores** in the cytoplasm feed the embryo until it implants and the placenta can supply it
- the **jelly coat** protects the egg cell, and **changes** once a sperm has entered
- so that no second sperm can enter, which keeps the chromosome number correct

### 3.3

(a)

- the **umbilical cord**
- the amniotic fluid **protects the fetus from knocks** and supports its weight

(b)

- from mother to fetus, any two of: **glucose, amino acids, oxygen**
- from fetus to mother, either: **carbon dioxide** or **urea**

(c)

- substances cross by **diffusion**, and a large surface area means **more can diffuse at once**
- a thin barrier gives a **short diffusion distance**, so diffusion is faster

(d)

- some **toxins** in tobacco smoke can **cross the placenta** into the fetus's blood
- **carbon monoxide** binds to the fetus's haemoglobin, so its blood carries **less oxygen**
- so the fetus receives less oxygen for respiration and grows more slowly, giving a low birth mass