

Solutions

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

2.1

- a gene is a **length of DNA that codes for a protein**
- an allele is an **alternative form of a gene**

2.2

- haploid: a nucleus containing a **single set** of chromosomes
- diploid: a nucleus containing **two sets** of chromosomes, a pair of each type

2.3

- body cell: **46** chromosomes, in 23 pairs
- sperm cell: **23** chromosomes

2.4

- the order of the bases sets the **order of the amino acids** in the protein
- a different order of amino acids gives the protein a **different shape**
- the protein's shape is what lets it do its job, so a changed shape may stop it working – for an enzyme, the **active site** no longer fits its substrate

2.5

- **enzymes**
- **membrane carriers**, which move substances across a cell membrane
- **receptors** for neurotransmitters

2.6

- the gene cannot leave the nucleus, but the ribosomes are in the **cytoplasm**
- so a **copy** of the gene is made, as mRNA, and it is the copy that travels to the ribosome

3.1 B

- all the body cells came from one zygote by mitosis, so they carry the same genes
- they differ because each one **expresses** only the genes for the proteins it needs
- **A** and **D** say the genes are missing, which they are not; **C** would make every cell identical

3.2

(a)

- the **gene** stays in the **nucleus**
- **mRNA** is made in the nucleus as a **copy of the gene**
- the mRNA **moves out of the nucleus** into the cytoplasm
- it **passes through a ribosome**

- the ribosome **joins amino acids** together into a protein
- the **order of the amino acids** is determined by the **order of the bases** in the mRNA

(b)

- the base sequence sets the **sequence of amino acids**
- a different sequence of amino acids folds into a **different shape**
- the shape decides what the protein can bind to, and so what it does – an enzyme's active site, a carrier's channel, a receptor's binding site

3.3

(a)

- they all developed from the **same zygote** by **mitosis** 有丝分裂, which produces genetically identical cells

(b)

- the insulin gene is present but is **not expressed** in a nerve cell
- a cell only makes the proteins it needs, and a nerve cell has no use for insulin

(c)

- the receptor is a protein whose **shape** is set by the order of its amino acids
- only a neurotransmitter with a **complementary** shape can fit and bind to it
- a molecule of any other shape does not fit, so it has no effect on that cell

(d)

- a body cell nucleus is **diploid**, with two sets of chromosomes (23 pairs)
- a sperm cell nucleus is **haploid**, with a single set (23 chromosomes)
- sperm cells are produced by **meiosis** 减数分裂

(e)

- the child is a **boy**
- every egg carries an **X** chromosome, so the mother can only ever contribute an X
- a sperm carries either an X or a **Y**, so it is the sperm that decides whether the pair is XX or XY