B1a Cell structure

1 cells

2 A microscope makes small things look larger/magnifies small things so they can be seen more clearly.

3 **a** Any one from: nucleus, cytoplasm (cell membrane and mitochondria cannot be seen clearly).

b ribosome

4 **a** controls what happens in the cell

b controls what enters and leaves the cell

5 **a** Any three from: cell membrane, nucleus, cytoplasm, mitochondria (not ribosomes as these are not visible in the cell).

b they make food/carry out photosynthesis

6 Any one from: cell membrane, cytoplasm.

F1 The cell wall protects the cell from bursting.
The nucleus controls what happens in the cell.
The large vacuole is where substances are stored.
The chloroplasts carry out photosynthesis to make food for the plant.
The cell membrane controls what goes into and out of the cell.

S1 Animal cells and plant cells are surrounded by a cell membrane, and the cytoplasm contains a nucleus, mitochondria and ribosomes. Plant cells also have some structures that animal cells don't, such as a cell wall, chloroplasts and a large vacuole.

B1a Core practical – Using a light microscope

1 light microscope (1)

2 stage (1)

3 making the image look clear (1)

4 **a** ×10 (1)

b You should focus on the image using the lowest magnification objective first./It is safer to start with the lowest magnification objective./You are less likely to crash the objective into the slide with the lowest power. (1)

5 Use a lower magnification objective to focus the image, (1) then return to the higher magnification and only use the fine focusing wheel to focus. (1)

6 **a** Any one from: lines are fuzzy not clean, the diagram has been shaded. (1)

b Any one from: did not use a ruler to draw label lines, label lines cross each other. (1)

7 **a** clear drawing of cell in photo C, using all the rules of drawing given in the method (1)

b drawing labelled using rules in method to show nucleus, cell membrane and cytoplasm (1)

8 The image is 3500 times larger than the real cell. (1)

9 Cells are too small to be seen by eye. (1) Microscopes magnify them so they appear large enough to see. (1)

10 10 × 20 = 200 (1)

11 diameter = $\frac{0.2}{10}$ (1) = 0.02 mm (1)

B1b Stem cells and specialised cells

1 as a single fertilised egg cell/by the fertilisation of an egg cell by a sperm cell

2 cell division

3 the baby contains trillions of cells and the embryo contains only a few/eight

4 **a** A stem cell is an unspecialised cell that can produce specialised cells.

b to produce all the different types of specialised cell in the developing baby

5 **a** it contracts/shortens, which helps to move other parts of the body

b it has a long cell fibre that carries electrical impulses to other parts of the body

6 Differentiation produces many different types of cell that each carry out particular functions well.

7 **a** it hardens so other sperm cells can't get into the egg cell

b The tail moves the sperm cell to the egg cell. The mitochondria provide energy so that the tail can move.

8 Adult stem cells produce specialised cells when a tissue grows or to replace damaged cells.

F1 Any one for each cell:

a Egg cell: cytoplasm contains lots of nutrients for cell division and growth after fertilisation/(haploid) nucleus contains DNA from mother so child inherits some of mother's characteristics/cell membrane hardens after one sperm cell has entered to prevent others entering.

b Sperm cell: long tail for moving to egg cell/many mitochondria provide energy for swimming/(haploid) nucleus contains DNA from father so child inherits some of father's characteristics/bag of enzymes at front of cell digests hole in egg cell membrane so sperm cell can enter.

c Nerve cell: long cell fibre that carries electrical impulses to other parts of the body/many connections to pass electrical impulses to other nerve cells.

d Muscle cell: can contract (shorten) to move other parts of the body such as bones.

S1 Stem cells in adult tissues produce specialised cells like those in the tissue. These are needed for growth or to replace damaged cells.

B1c Growth

1 getting bigger

2 **a** increased/got bigger

b it has grown

3 Any suitable suggestion, such as: change in mass, length, leaf area.

4 mitosis

5 **a** has pairs/two sets of chromosomes in the nucleus of a cell

b they have exact copies of the chromosomes in the parent cell

6 Offspring produced by asexual reproduction have one parent. Offspring produced by sexual reproduction have two.

7 Any suitable answer that includes reference to plantlets growing from cells that contained identical copies of chromosomes to those in the parent plant cells, for example, The plantlets have formed by asexual reproduction/ by mitosis from the parent plant.

F1 In animals and plants the cells divide to make more cells. In plants, cells also elongate.

S1 Any suitable answer that refers to cell division by mitosis followed by growth and differentiation, for example, Mitosis of cells in the leaf of the parent plant produced new cells. These cells elongated and then differentiated to form all the different types of cell in a whole plant, such as leaf cells and root cells.

B1d The nervous system

1 to carry electrical impulses

2 **a** Any suitable organ, e.g. eye, ear, skin.

b muscles (or glands)

3 **a** sensory neurones, relay neurones, motor neurones

b relay neurone

4 **a** carries the impulse to the next neurone or an effector

b carries the impulse from receptor cells

c insulates the neurone

5 **a** the place where two neurones meet

b electrical impulses cannot cross the gap

c Neurotransmitter can only be released from axon terminals. Only one of the neurones has axon terminals at the synapse.

6 **a** a simple pathway of neurones that links receptor cells in a sensory organ to effector cells

b they allow fast, automatic responses to avoid danger

F1 **a** it carries impulses from receptor cells to relay neurones in the spinal cord

b it carries impulses from sensory neurones to motor neurones

c it carries impulses from relay neurones in the spinal cord to effector cells

d it allows an impulse to cross a synapse

e it insulates the neurone

f it allows rapid, automatic responses to a stimulus

S1 Flow chart similar to the following (order must be correct, though detail of content may vary): receptor cells in skin detect heat stimulus → receptor cells trigger an electrical impulse in the sensory neurone → impulse reaches axon terminals of sensory neurone → neurotransmitter released into gap in synapse → triggers impulse in relay neurone → impulse reaches axon terminals of relay neurone → neurotransmitter released into gap in synapse → triggers impulse in motor neurone → impulse reaches effector cells in muscles → muscle cells respond by contracting and moving hand away from heat.

B1e DNA

1 nucleus

2 DNA contains the genetic code.

3 Any suitable sentence containing all four words, such as: DNA is a molecule packaged inside chromosomes, which are found in the nucleus of a cell.

4 **a** two
b base pairs
c double helix
d the order of the bases

5 **a** DNA
b It codes for a specific protein.

6 **a** all the DNA in the organism
b they have different genes

7 The cell nuclei, because that's where the DNA is in a cell.

F1 Any suitable relationships, e.g.:
DNA is packaged into chromosomes, chromosomes are made of many genes, chromosomes are found in the nucleus of a cell, a gene is a section of DNA that codes for a protein.

S1 Any suitable similarities, such as:
- The two backbones of a DNA molecule are like the two supporting sides of the staircase.
- The steps of the staircase are like the base pairs of the DNA molecule, joining the two sides together.

B1f Inheritance

1 We inherit chromosomes and genes in gametes from our parents.

2 sex chromosomes

3 Y

4 The sperm cell/father's gamete determines the sex of the baby.

5 The gene has different alleles. One allele causes red hair, another allele causes fair hair.

6 **a** phenotype: both brown coat; genotype: both Bb
b Body cells contain two copies of the coat colour gene. The different alleles separate when the gametes form./Each gamete contains only one copy of the gene.

7 Any suitable description, such as: Dominant means the allele affects the phenotype if at least one copy is in the genotype. B is dominant because Bb gives brown not black coat colour.

Recessive means the allele only affects the phenotype if the dominant allele is not present. So b is recessive because only bb gives black fur.

Heterozygous means the two alleles for a gene are different in the genotype. Bb is heterozygous because there are two different alleles.

Homozygous means the two alleles for a gene are the same in the genotype. BB and bb are homozygous because both alleles in the genotype are the same.

8 If both brown rabbits have the Bb genotype, then a sperm containing a b allele could join with an egg containing a b allele. The offspring will then be bb and have a black coat.

F1 Rr will have purple flowers.

S1 Definitions should be similar to those given in the Word Sheets for topics B1e and B1f.

B1g Variation

1 differences in characteristics

2 any two suitable examples, e.g. sex, skin colour, hair colour, height, body shape

3 The child inherited the characteristic in the genes from his father.

4 The differences in fur colour are caused by differences in alleles/genes.

5 The children have a mutation in their genes that has stopped them making the pigment that causes dark skin.

6 hair cutting/scissors

7 **a** yes
b Exercise can change body mass during a person's life.

8 How tall you grow is affected by genes for bone growth, and genes for how nutrition affects bone growth. Environmental causes could include the type and amount of food eaten, diseases of bone or muscle, amount of exercise etc., which would affect how well bones and muscles grow.

F1 Any suitable genetic cause, e.g. difference in alleles for genes that affect height/mutation in a gene that affects height.

Any suitable environmental cause, e.g. quality of diet during childhood, health during childhood, damage caused by an accident.

S1 The child will have inherited his natural hair colour and structure from his parents, because these are characteristics that are controlled by genes. So the child may have inherited the alleles for wavy blonde hair from his father. His mother may naturally have brown hair, or may have dyed it. So hair colour can be changed by the environment (hair dye). She may also naturally have straight hair, or may

have curly hair that she has straightened using heat. So hair structure can also be changed by the environment. Variation in hair length is environmental variation as it depends on how the hair is cut.

B1h Evolution and natural selection

1 change over time

2 **a** *Ardipithecus ramidus*

b It has increased over time, so more recent human-like species have larger skull volumes.

3 **a** More modern tools are more complicated and shaped to increase their cutting edge.

b Any suitable reason, such as: learning how to make a tool is passed on through generations, including improvements to tools; bigger skull means bigger brains so may mean better able to make more complicated tools.

4 **a** Natural selection is how the environment affects the survival of organisms based on their characteristics.

b better able to survive in an environment

c Skin colour changed from dark to paler because paler people in northern places were healthier/produced more vitamin D and so lived longer and had more offspring.

5 **a** bacteria that are not killed/affected by antibiotics

b Antibiotics kill the bacteria that are not resistant. Only the most resistant bacteria are left to reproduce and pass on their resistance to their offspring.

F1 Something similar to the following: variation in characteristics due to genetic variation → some variations increase chance of survival and reproduction → those variations are passed on to offspring → more individuals in the next generation have the 'useful' variations.

S1 Evidence from diagram B shows that skull size increased, which means that brain size probably also increased. Evidence from tools over time shows that they became more complicated, which suggests more brain power.

B1i Selective breeding and genetic engineering

1 When people change the characteristics of animals or plants over time by selecting certain individuals for breeding.

2 they are small enough to hunt rabbits in their burrows

3 **a** amount of milk they produce/producing lots of milk

b we drink/use the milk they produce

4 **a** a plant that is not affected (or less affected) by a disease

b The plants will grow better, which means more food for us.

c Wheat plants that show some disease resistance are bred together. The plants grown from the seed they produced are tested for disease resistance. The plants with the best disease resistance are bred together. This is repeated over many generations.

5 **a** The GM salmon contain a gene that helps them grow faster than non-GM salmon.

b we get more food more quickly

c If they breed with wild salmon, the gene could pass to the wild animals. Plus any suitable suggestion of the impact of this, such as: Wild salmon would grow faster and eat more, which could affect the food chain.

F1 Any suitable example and how it has changed, such as:
– Jack Russells bred to be smaller than other dog breeds.
– Holstein–Friesian cows bred to produce more milk than other breeds.
– Some wheat plants bred to be resistant to diseases.

F2 Any suitable example and how it has changed, such as:
– AquAdvantage® salmon grow faster than non-GM salmon.

S1 Benefits include: The GM wheat plants will grow better and have a higher yield. This will make more food for the farmer to sell.

Problems include: The GM plants could be a problem because there will be no insects in the field for other animals to feed on.

Other answers are possible.