Active Biology - Senior Biology student worksheets part 1 **(second edition) contains the following worksheets (including answer sheets):**

CELL ORGANELLES AND THEIR FUNCTIONS

Using a system of colour-coding, match the name of the organelle to its correct function:

Lysosomes

Packaging of proteins for export from cell

Cell wall

Structural support in plants

nucleus

Fluid part of a cell

Synthesis of proteins

Chloroplast

Production of ATP

Ribosomes

Control centre of cell

Plasma membrane

Transport of proteins within cell

Contains enzymes responsible for breakdown of debris

Smooth endoplasmic reticulum

Cytosol

Vacuole

Synthesis of lipids and steroid hormones

Photosynthesis

Golgi complex

Mitochondria

Storage facility for fluid, enzymes, nutrients

Controls what enters and leaves the cell

Rough endoplasmic reticulum

CELL ORGANELLES AND THEIR FUNCTIONS
(answers)

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PLANT ADAPTATIONS

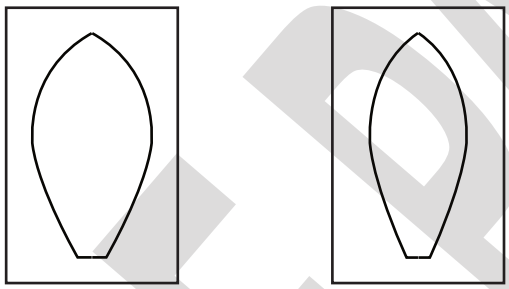
This task should be carried out in pairs, with one student constructing 'leaf **A**' and the other constructing 'leaf **B**'.

AIM: to investigate the various adaptations displayed by plants that live in a hot, dry climate.

MATERIALS: 2 pieces of A4 paper (one per student), grey-lead pencil, highlighters or coloured pencils, scissors; sticky tape; glue stick; cling wrap.

INSTRUCTIONS:

1. Draw a large outline of a leaf on your piece of A4 paper and use the scissors to cut it out. Leaf **A** and leaf **B** should be approximately the same length, but make leaf **A** wide and leaf **B** narrow:



Leaf **A** Leaf **B**

(i) Which shape, wide (leaf **A**) or narrow (leaf **B**) would be better for keeping the leaf cooler on a hot day? Why?

_____

_____

2. On one side of your leaf, draw the main (midrib) vein running down the centre of the leaf, as well as some branching veins. This is the *upper* side of the leaf.

3. Turn the leaf over and on its lower side, draw some small circles to represent the pores, or *stomata*, of the leaf. On leaf **A**, draw 40 stomata, and on leaf **B**, draw 10.

(ii) For a plant that lives in a hot, dry area, would it be better to have many stomata or fewer? Why?

_____

_____

4. Pick up leaf **A** and hold it so that it is positioned *horizontally*. Pick up leaf **B** and hold it so that it hangs *vertically*.

(iii) With the sun directly overhead, which leaf, **A** or **B**, would be more likely to overheat on a hot day? Explain.

_____

_____

5. Hold your leaf horizontally so that the lower side faces the ceiling. Roll the leaf into a tube by curling its edges inwards on both sides and use a piece of sticky tape to hold it.

(iv) Having leaves that roll inwards can help to minimise water loss from the leaf. Suggest why.

_____

_____

6. Unroll your leaf and draw some 'hairs' on the upper and lower surfaces, particularly around the stomata.

(v) Why do you think many plants that live in hot, dry conditions have hairs on their leaves?

_____

_____

7. Use a glue stick to create a sticky surface on the upper side of your leaf, then place some cling wrap over the top of it. Cut the cling wrap to match the shape of your leaf. This represents the leaf's cuticle, a waxy layer.

(vi) Some plants benefit from having a very thick cuticle on their leaves. Explain why.

_____

_____

(vii) In conclusion, make a list of all the features seen here that help plants to survive in hot, dry climates.

_____

_____

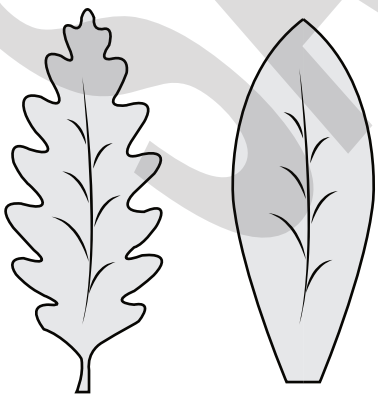
8. Extension:

(viii) What are 'sunken' stomata and how do they assist survival?

_____

_____

(ix) Which of the leaves shown would be better adapted to living in a hot, dry environment? Explain.



X **Y**

_____

_____

_____

_____

_____

_____

_____

PLANT ADAPTATIONS
(answers)

(i) A narrow shape would keep the leaf cooler as there is less surface area exposed to the sun so less heat is absorbed. Water loss is also minimised.

(ii) It is better to have fewer stomata because this reduces the amount of water lost through the stomata by transpiration.

(iii) Leaf **A** would be more likely to overheat because it is exposing more surface area to direct sunlight. Leaf **B** is orientated vertically so there is less exposure to the sun and thus less heat gain.

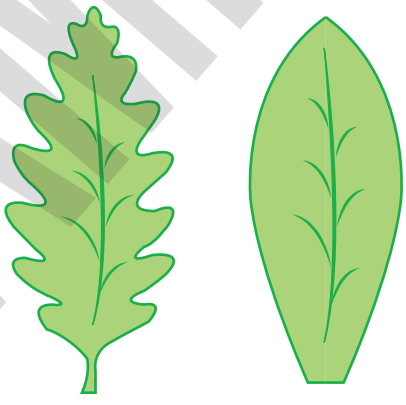
(iv) When the leaf rolls inwards, this creates a humid 'chamber' and the stomata are no longer exposed to the environment. The increased humidity also slows the loss of water through the stomata because the concentration gradient of water vapour from inside the leaf to outside is less steep.

(v) Having hairs on their leaves helps to reduce the speed of airflow over the surface of the leaves, which in turn reduces the rate of transpiration, or loss of water from the leaves.

(vi) Although most water loss from a plant occurs through the stomata, some is also lost from other parts of the leaf surface. Having a thick, waxy cuticle reduces this loss.

(vii) Narrow leaves, fewer stomata, vertical orientation of leaves, leaves that can roll inwards, presence of hairs, thick cuticle.

(viii) 'Sunken' stomata are located in pits below the leaf surface, rather than being situated *on* the surface. As a result, the air spaces surrounding these stomata tend to become more humid, reducing water loss by transpiration.

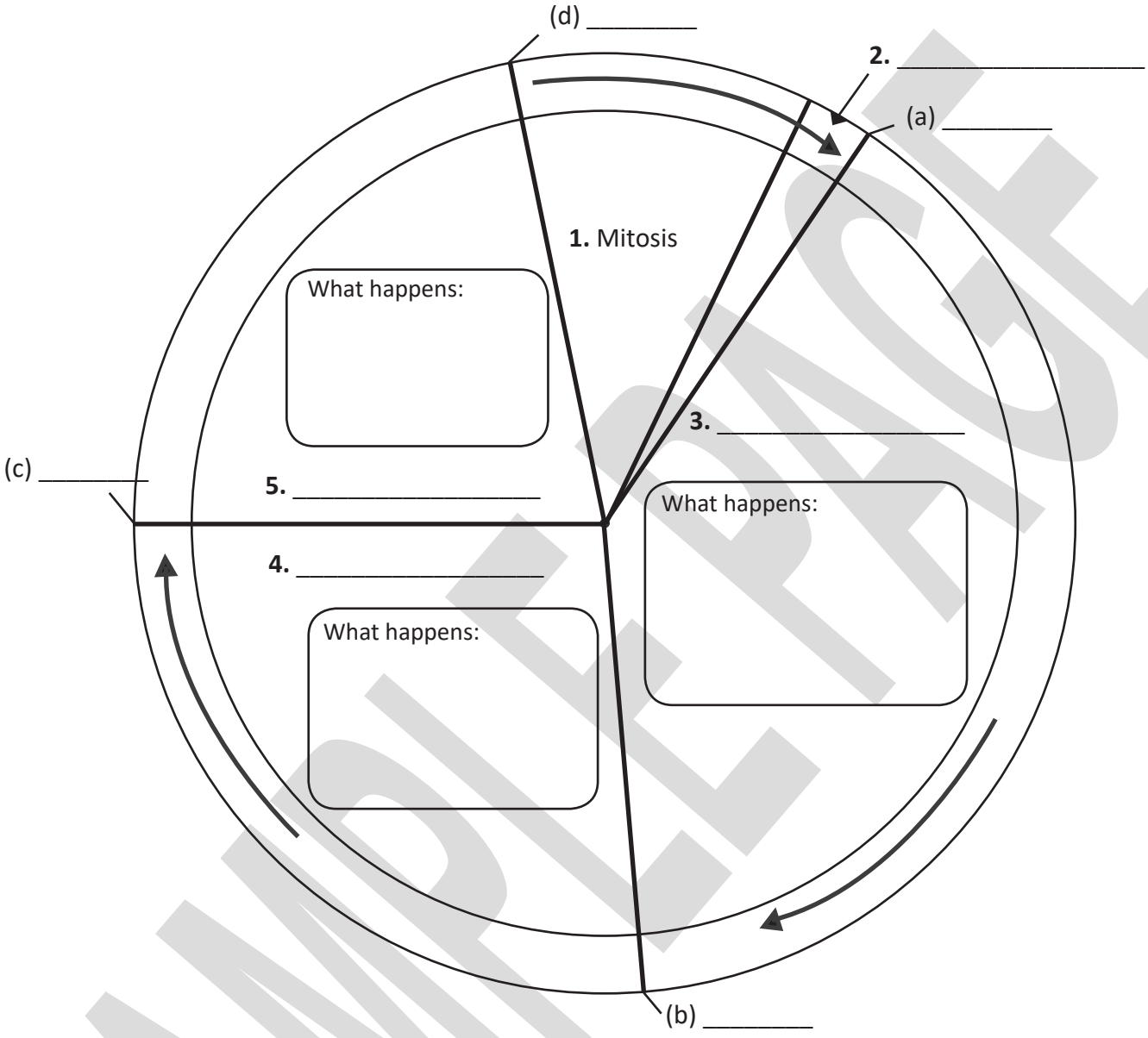


X **Y**

(ix) Leaf **X** would be better adapted to living in a hot dry climate because it has lobed margins, giving it a larger *ratio of edge length to surface area* of the leaf. Because leaves are thinnest at their margins and lose more heat from these thinner areas, leaf **X** would cool faster than leaf **Y**. This in turn means that it will also have a lower transpiration rate than leaf **Y**.

THE CELL CYCLE

The following diagram shows the cell cycle:

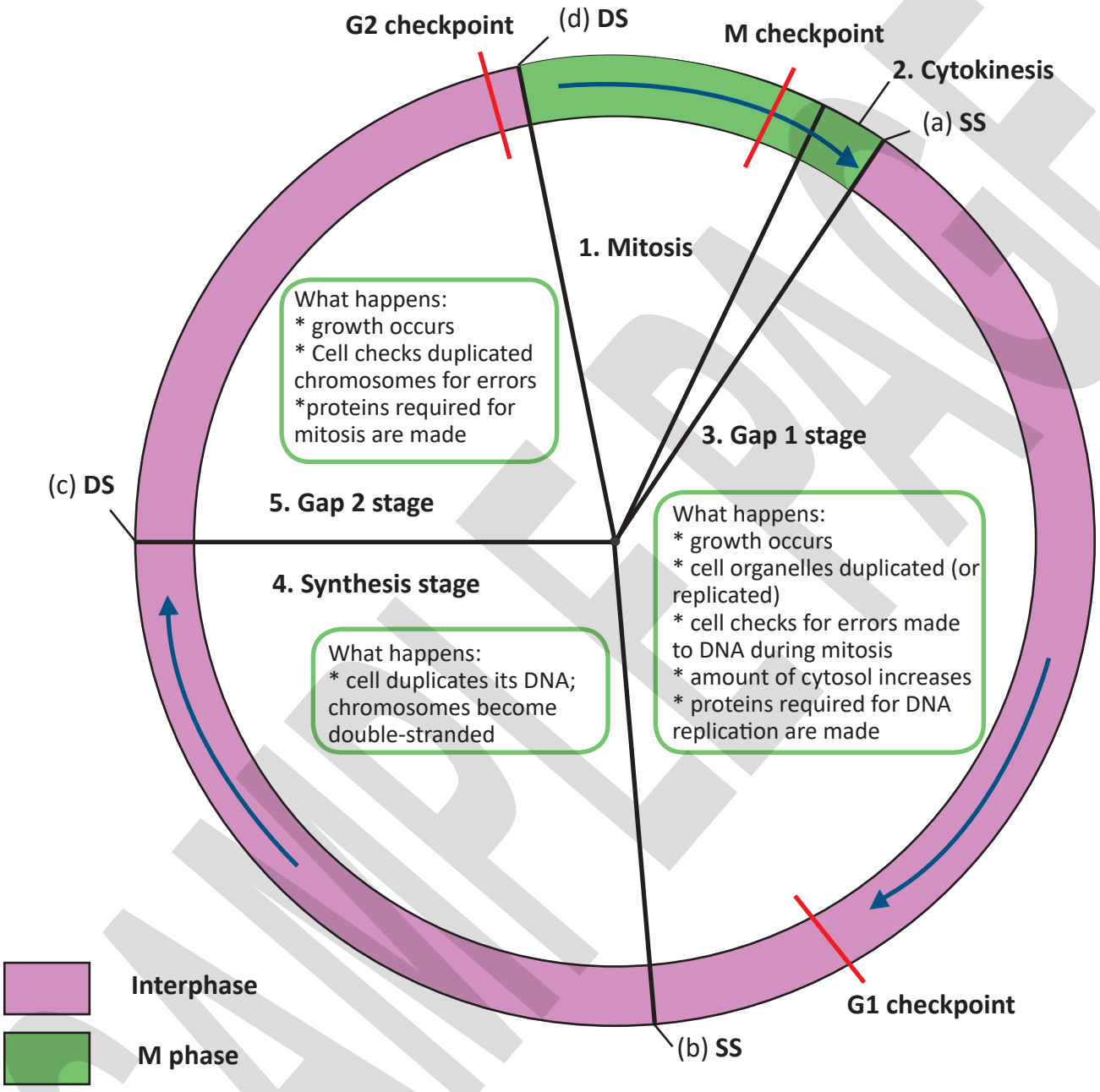


1. On the diagram, add the names of the stages **2**, **3**, **4** and **5**.
2. In the spaces provided, briefly describe what happens during stages **3**, **4** and **5**.
3. At each point (a), (b), (c) and (d), indicate whether the DNA is single-stranded (**SS**) or double-stranded (**DS**).
4. Which stages make up (i) the *M phase*? (ii) *Interphase*? Use colour-coding and a key to show this.
5. On the diagram, show the positions of the three 'checkpoints' in the cell cycle.
6. At one of the checkpoints is a protein, p53, which acts as a 'tumour supressor'; its job is to stop cells with damaged DNA from continuing on through the cell cycle. What would happen if p53 malfunctioned?

_____

_____

THE CELL CYCLE
(answers)



1. See above diagram.

2. See above diagram.

3. See above diagram.

4. The M phase consists of Mitosis and Cytokinesis (shown in green); Interphase consists of the G1, S and G2 stages (shown in purple).

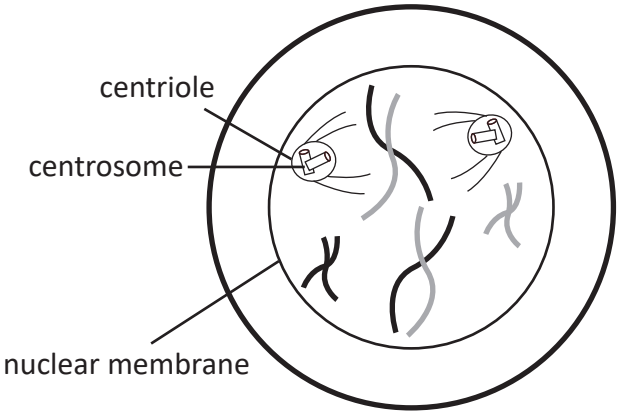
5. See above diagram.

6. If the p53 protein malfunctioned, damaged cells would continue on through the cell cycle unchecked, leading to proliferation of these cells. This can lead to cancer.

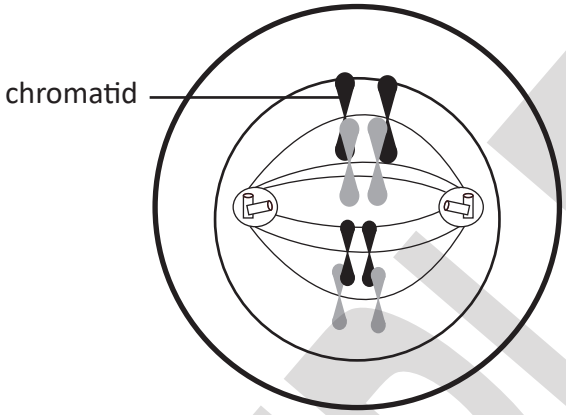
MITOSIS

The following diagrams show a cell, containing two pairs of double-stranded chromosomes, undergoing mitosis. The pairs differ in size (one long, one short) and the two members of each pair have been distinguished by colour/shade. Each of these diagrams contains some errors. Re-draw each one, correcting these errors.

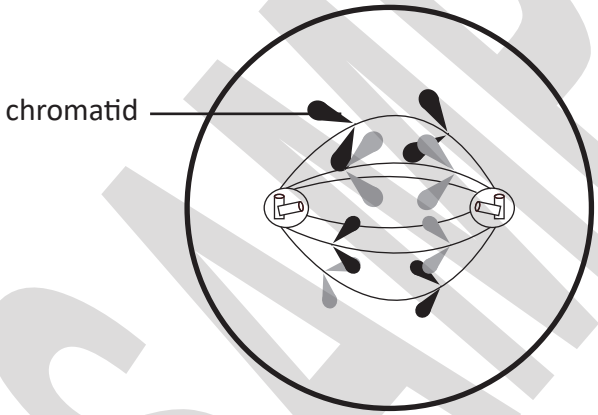
PROPHASE



METAPHASE

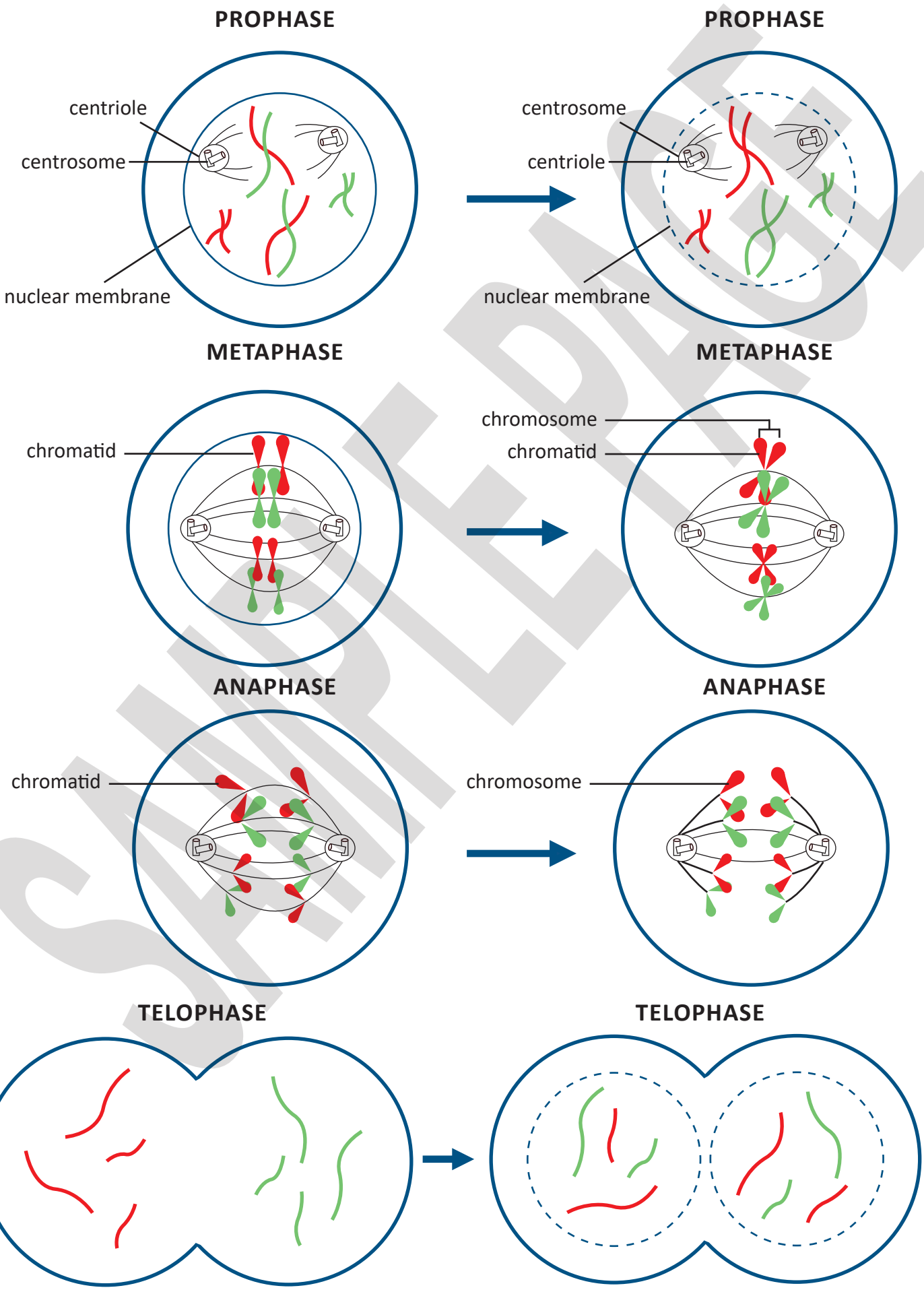


ANAPHASE



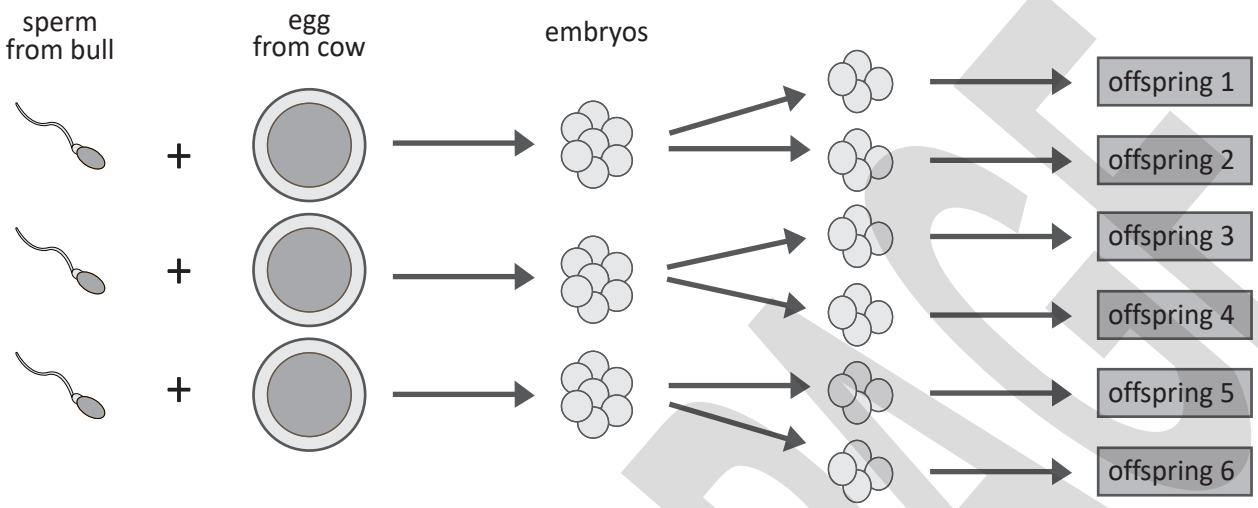
TELOPHASE

MITOSIS
(answers)



ANIMAL CLONING

1. The following diagram illustrates the process of *embryo splitting*, a technique used in the artificial cloning of animals.



(a) Which of the offspring **1** - **6** will be clones of each other? Explain.

_____

_____

(b) Explain why offspring **1** and offspring **6** will NOT be identical.

_____

_____

(c) Will the offspring produced be identical to either of the parents? Explain.

_____

_____

(d) In this process, each embryo will be implanted into a surrogate cow. Does this cow make any genetic contribution to the offspring? Explain.

_____

_____

2. The technique of embryo splitting has been used in the livestock industry for many years. What are the advantages of using this technique?

_____

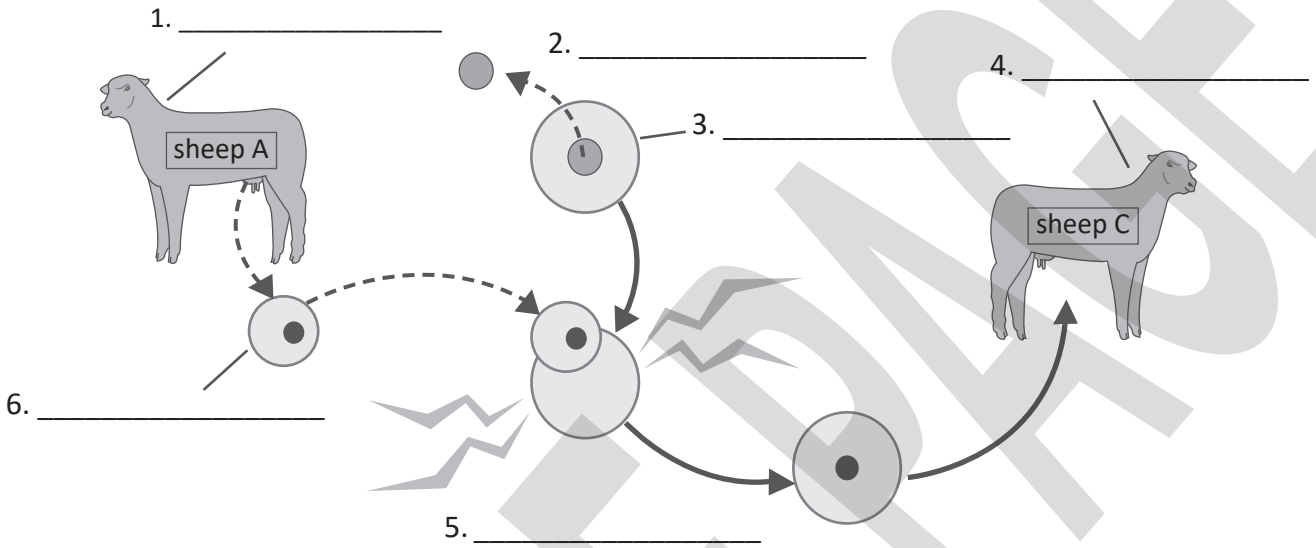
_____

_____

3. Another technique used in the artificial cloning of animals is SCNT. What does this stand for?

_____

4. The diagram below shows some of the steps involved in creating 'Dolly the sheep' using SCNT.



(a) Using the following word list, label numbers **1** - **6** on the diagram.

enucleation - **surrogate ewe** - **somatic cell** - **nuclear donor** - **cell fusion** - **donor egg**

(b) Another sheep used in this process, sheep **B**, is not shown in the diagram. Explain the role played by sheep **B** in creating Dolly.

_____

(c) To which sheep, **A**, **B** or **C**, would Dolly be identical? Explain.

_____

_____

5. Dolly was not the first animal to be cloned using nuclear transfer. What made her so special?

_____

6. The cloning of animals using SCNT is not without problems. Describe two problems/difficulties that have been associated with this technique.

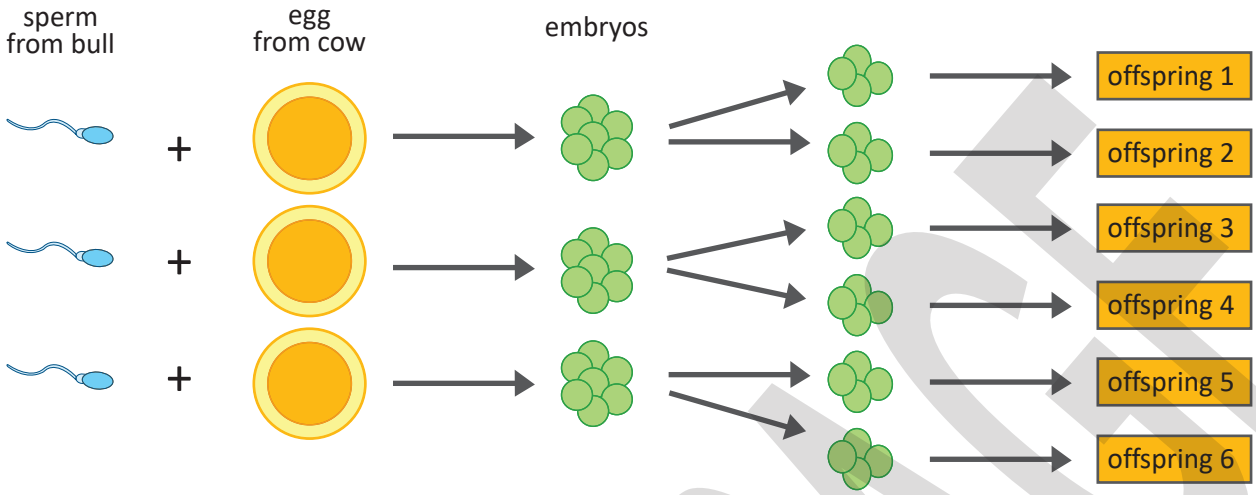
_____

_____

_____

_____

ANIMAL CLONING
(answers)



1. (a) Offspring **1** and **2** will be clones, as will offspring **3** and **4** and offspring **5** and **6**. This is because in each case, the two offspring have come from the same embryo before it was split.

   (b) Offspring **1** and offspring **6** will *not* be identical because they are the result of two different sperm fertilising two different eggs. They will therefore be siblings, but not clones.

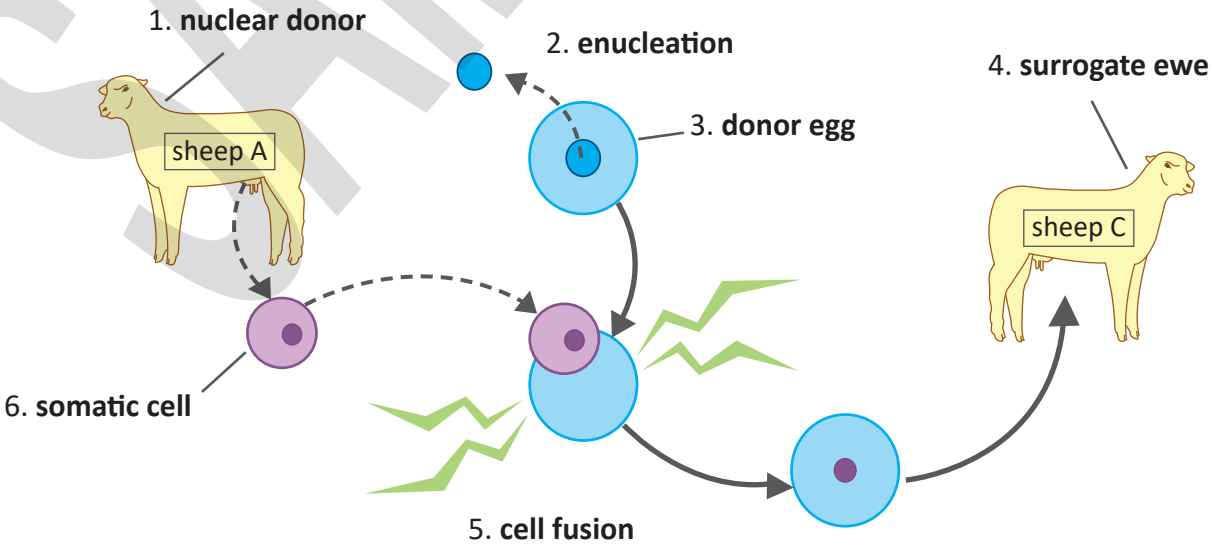
   (c) The offspring will not be identical to either parent because each will have received half the genetic material from one parent (the bull), and half from the other (the cow). They will therefore be a genetic mix of both parents.

   (d) The surrogate cow does not contribute any genetic material to the offspring because it was not her eggs that were used, but those of another cow.

2. The advantage of using embryo splitting is that the breeder can increase the number of offspring produced by a stud bull or a prized cow. The parents are chosen because they possess certain desirable characteristics, such as high milk yield in the cow, or lean muscle in the bull, and by splitting the embryo, two calves are produced from each fertilised egg instead of just one.

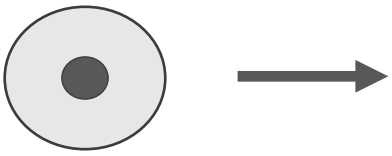
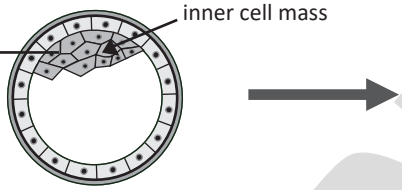
3. Somatic Cell Nuclear Transfer.

4. (a) See diagram below.

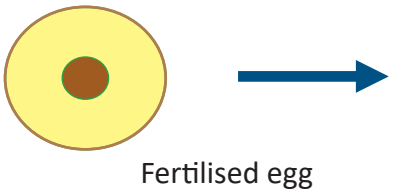
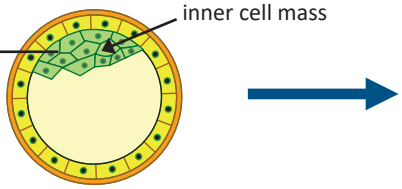
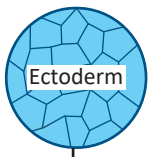
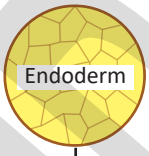
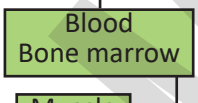
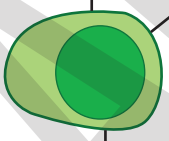
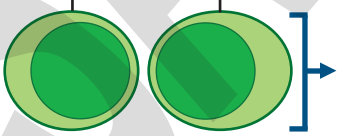


TYPES OF STEM CELLS

Complete the boxes below by (i) identifying the *type* of stem cell involved (pluripotent, unipotent, multipotent, oligopotent or totipotent and (ii) describing the nature of each of these groups of stem cell.

Source of stem cells	Type of stem cells (potency)	Description of stem cells
 Fertilised egg	1. _____	1. _____
 Four-cell embryo	2. _____	2. _____
 Blastocyst	3. _____	3. _____
Ectoderm, Mesoderm, Endoderm	4. _____	4. _____
Skin, Brain; Blood, Bone marrow, Muscle; Liver	5. _____	5. _____
Haematopoietic stem cell; Neural stem cell	6. _____	6. _____
Lymphoid stem cell; Myeloid stem cell	7. _____	7. _____
Muscle stem cell	8. _____	8. _____

TYPES OF STEM CELLS
(answers)

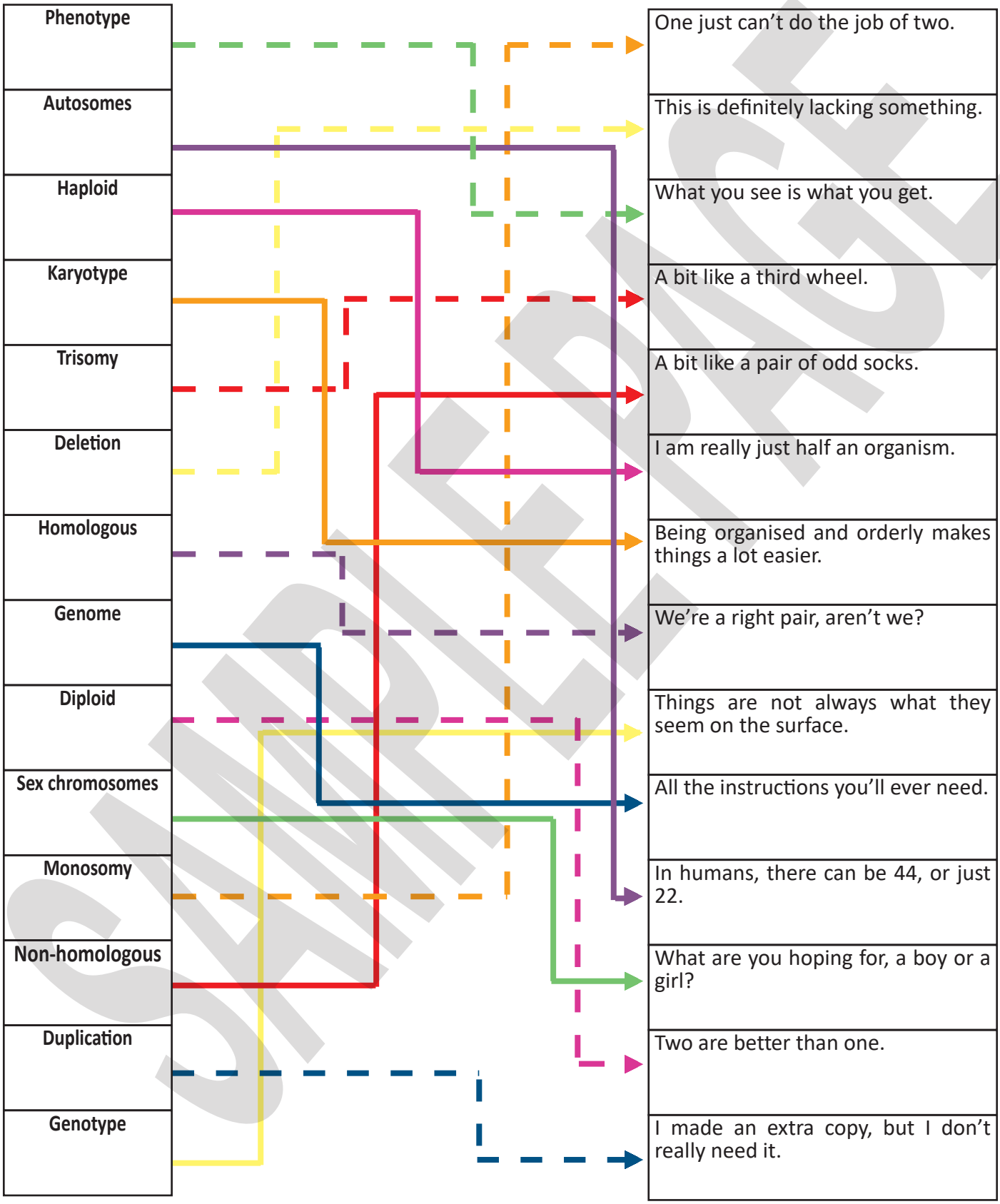
Source of stem cells	Type of stem cells (potency)	Description of stem cells
 Fertilised egg	1. Totipotent	1. **Totipotent stem cells** are found in the fertilised egg and in early embryos up to eight cells in size. They have the ability to differentiate into *any* kind of cell.
 Four-cell embryo	2. Totipotent	2. **Pluripotent stem cells** are found in the inner cell mass of a blastocyst as well as the three germ layers. They can differentiate into most kinds of cells, but not all.
 Blastocyst	3. Pluripotent	3. **Multipotent stem cells** are found in many tissues of the body, including the bone marrow, skin, liver, brain, blood and heart. They can differentiate into some, closely related cells.
	4. Pluripotent	
		
		
	5. Multipotent	4. **Oligopotent stem cells** are those that can differentiate into a few types of cells only. Examples include *lymphoid* as well as *myeloid* stem cells, both of which can give rise to various types of blood cells.
		
		
		
		
	6. Multipotent	5. **Unipotent stem cells** are those that can give rise only to cells of their own type. They also have the ability to self-renew. Muscle stem cells are an example.
 Neural stem cell		
	7. Oligopotent	
 Muscle stem cell	8. Unipotent	

GENETICS: IMPORTANT TERMS

Connect the terms on the left with the 'clues' on the right:

Phenotype	One just can't do the job of two.
Autosomes	This is definitely lacking something.
Haploid	What you see is what you get.
Karyotype	A bit like a third wheel.
Trisomy	A bit like a pair of odd socks.
Deletion	I am really just half an organism.
Homologous	Being organised and orderly makes things a lot easier.
Genome	We're a right pair, aren't we?
Diploid	Things are not always what they seem on the surface.
Sex chromosomes	All the instructions you'll ever need.
Monosomy	In humans, there can be 44, or just 22.
Non-homologous	What are you hoping for, a boy or a girl?
Duplication	Two are better than one.
Genotype	I made an extra copy, but I don't really need it.

GENETICS: IMPORTANT TERMS
(answers)



HUMAN VARIATION

The following shows eight pairs of inherited traits in humans. For each pair, one trait is dominant and the other is recessive.

tongue roller

non-roller

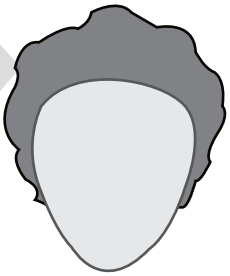
attached ear lobe

free ear lobe

cleft chin

no cleft

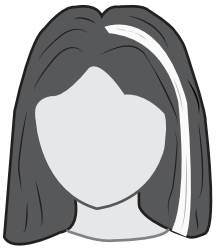
widow's peak



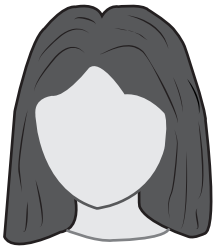
straight hairline

straight hair

curly hair



white hair streak



no white streak

shorter second toe

longer second toe

red hair

non-red hair

1. Count the number of people in your class with each characteristic and complete the appropriate columns in the following table:

Characteristic	Number	Characteristic	Number	Dominant trait (prediction)	Dominant trait (actual)
Tongue roller		Non-roller			
Attached ear lobe		Free ear lobe			
Cleft chin		No cleft			
Widow's peak		Straight hairline			
Straight hair		Curly hair			
White hair streak		No white streak			
Shorter second toe		Longer second toe			
Red hair		Non-red hair			

2. Predict which trait in each pair is the dominant one and complete the appropriate column in the table. What did you base your decision on?

_____

3. (a) Use the Internet to find out which traits actually *are* dominant and complete the last column in the table. Were your predictions correct?

_____

_____

(b) Which result/s surprised you the most? Why?

_____

_____

4. (a) Are dominant traits necessarily more common amongst populations? Search the Internet to find at least three examples of dominant traits that are less common than recessive ones.

_____

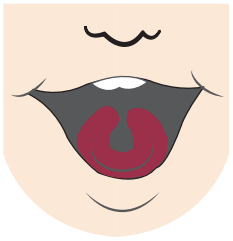
_____

(b) For each of the traits you listed, what is the *incidence* of the dominant one?

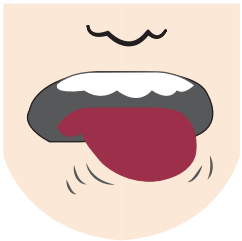
_____

_____

HUMAN VARIATION
(answers)



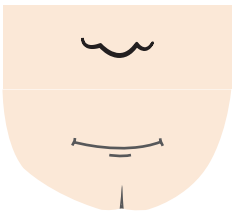
tongue roller



non-roller

attached ear lobe

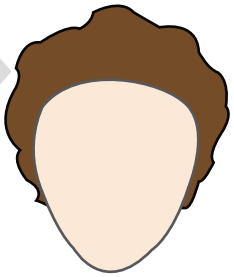
free ear lobe



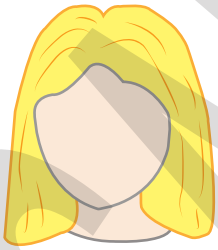
cleft chin

no cleft

widow's peak

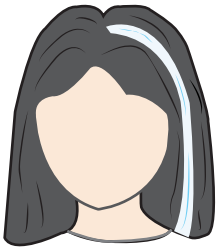


straight hairline

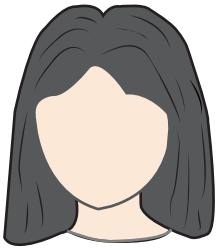


straight hair

curly hair



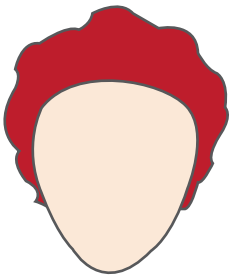
white hair streak



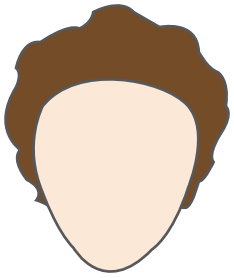
no white streak

shorter second toe

longer second toe



red hair



non-red hair

1. Student answers will depend on numbers of persons in class with the characteristic.

Characteristic	Number	Characteristic	Number	Dominant trait (prediction)	Dominant trait (actual)
Tongue roller		Non-roller			Tongue rolling
Attached ear lobe		Free ear lobe			Free ear lobe
Cleft chin		No cleft			Cleft chin
Widow's peak		Straight hairline			Widow's peak
Straight hair		Curly hair			Curly hair
White hair streak		No white streak			White hair streak
Shorter second toe		Longer second toe			Longer second toe
Red hair		Non-red hair			Non-red hair

2. Student answers will vary. Commonly, students base their predictions on the numbers obtained for each characteristic, believing that a trait is more likely to be dominant if it is more common. Some predictions may also be based on the student's general knowledge; many already know, for example, that red hair is due to a recessive gene.

3. (a) See above table. Student answers will vary in terms of the accuracy of their predictions.

   (b) Student answers will vary.

4. (a) Student answers will vary. Some examples of dominant traits that are less common than recessive ones include: achondroplasia (dwarfism), polydactyly (having extra fingers and/or toes), tone deafness and having webbed fingers or toes (so dominant traits are *not* necessarily more common in populations).

   (b) Student answers will vary. For the traits listed in 4 (a), the incidences are:
   Achondroplasia - 1 in 20,000 - 30,000 births.
   Polydactyly - 1 in 1000 births.
   Tone deafness - 4% of the population.
   Webbed fingers or toes - 1 in 2,000 - 3,000 births.