CAPITOLO 1

VERIFICA LE TUE CONOSCENZE

1 A
2 A
3 B
4 D
5 B
6 A
7 A
8 D
9 D
10 D
11 A
12 C

VERIFICA LE TUE ABILITÀ

13 A prima, B alleli, C segregazione
14 A mutazioni, B selvatico, C polimorfico
15 A autosomi, B ZZ, C femminile, D maschile
16 B D
17 B D
18 C D

METTITI ALLA PROVA

32 B
33 A
34 A
35 D
36 A
37 E
38 E
39 A
40 D
41 D
42 D
43 D
44 B

The wisdom of the rabbis

- Why the rabbis faced a dilemma?

A mother brought her 8-day-old son to the rabbi for ritual penile circumcision. The rabbi knew that the woman's two previous sons had bled to death when their foreskins were cut.

- How did he solve it?

Without any knowledge of our modern concepts of genes and genetics, the rabbis had linked a human disease (which we now know as hemophilia A) to a pattern of inheritance (which we know as sex linkage). Only in the past few decades have the precise biochemical nature of hemophilia A and its genetic determination been worked out.

CAPITOLO 2

VERIFICA LE TUE CONOSCENZE

1 C
2 D
3 C
4 B
5 A
6 B
7 C
8 B
9 B
10 B
11 A
12 B

VERIFICA LE TUE ABILITÀ

13 A cristallografia, B appaiamento, C tridimensionali
14 A guanina, B idrogeno, C dieci, D antiparallele
15 A complesso, B *ori*, C forcelle, D eliche
16 A B
17 A D
18 A C

METTITI ALLA PROVA

29 A
30 B
31 C
32 B
33 C
34 A
35 C

A structure for our times

- What happens in Michael Crichton's novel Jurassic Park?

In the story, the scientists isolated the DNA of dinosaurs from fossilized insects that had sucked the reptiles' blood. The insects, which had been preserved intact in amber (fossilized tree resin), yielded DNA that could be used to produce living individuals of long-extinct organisms such as Tyrannosaurus rex.

- Why does DNA's structure stir our society?

It is what that structure symbolizes, which is nothing less than the promise and perils of our rapidly expanding knowledge of genetics.

CAPITOLO 3

VERIFICA LE TUE CONOSCENZE

1 D
2 B

3 C
4 D
5 D
6 A
7 B
8 B
9 D
10 D
11 A
12 C

VERIFICA LE TUE ABILITÀ

13 A promotore, B sito, C 3'—5', D primario
14 A amminoacil tRNA sintetasi, B anticodone, C allungamento, D stop
15 A puntiformi, B frameshift, C silenti, D cromosomiche
16 B D
17 A D
18 B D

METTITI ALLA PROVA

31 B
32 A
33 D
34 C
35 A
36 A
37 C
38 D
39 E
40 B
41 A
42 C
43 D
44 B

Toxic avenger at the ribosome

• What happened to Georgi Markov in 1978?

A man—possibly a Bulgarian secret agent—brushed up against him and, seemingly by accident, poked him with an umbrella. Markov felt a sharp pain. Within a few hours, he started to feel weak. A high temperature, vomiting, and more severe symptoms soon followed. Two days later he was dead.

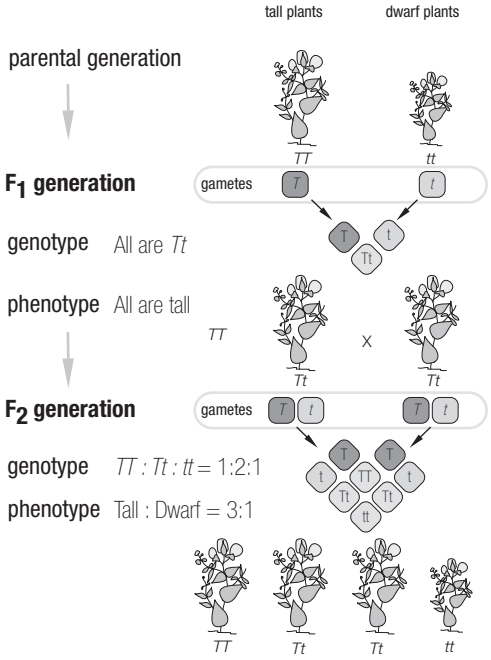
• What is ricin?

A highly toxic molecule isolated from the seeds of the tropical castor bean plant, Ricinus communis. The seeds of Ricinus have been used for centuries as a source of castor oil, a natural product once frequently administered to children to «clean out» the digestive tract.

Biology in English (pages B93-B100)

1A a. *False* – His work had no discernible influence on the scientific community for about 30 years; b. *True*; c. *False* – This is the definition of character. A trait is a particular form of a character, e.g. white or purple flower; d. *False* – F_2 plants; e. *False* – The ratio of dominant-recessive; f. *True*; g. *False* – He had no knowledge of chromosomes or meiosis; h. *True*.

1B



1C 1. To avoid self-pollination; 2. He had isolated each strain by crossing sibling plants or allowing self-pollination; 3. Yes.

2 1: h; 2: d; 3: l; 4: a; 5: e; 6: k; 7: b; 8: j; 9: f; 10: c; 11: i; 12: g.

3 a. Diploid; b. True-breeding; c. Phenotype; d. Haploid; e. Parental generation P; f. Law of independent assortment; g. Second filial generation F_2; h. Pleiotropic; i. First filial generation F_1.

4 a. It is recessive because A and his husband do not have the condition, but they have a son that is polydactyl; b. A-*Pp*, B-*Pp*, C-*pp*.

5 1: disease; 2: amino acid; 3: allele; 4: red blood cells; 5: capillaries; 6: oxygen; 7: parasite; 8: carrier; 9: malaria; 10: plasmodium.
a: *ss*; b: Both *Ss*; c: ½; d: 1/8.

6 a. The first fly was homozygous recessive, while the second was heterozygous, as the diagram shows and in which we can see that the probability of each phenotype is 50%.

b.

	l	***l***
L	*Ll*	*Ll*
l	*ll*	*ll*

7 a. Genotype: *RrTt*.
b. Phenotype: Yellow fruit, tall.
c. *RrTt* X *rrTt*.
d.

	rT	***rt***
RT	*RrTT* Red fruit, tall	*RrTt* Red fruit, tall
Rt	*RrTt* Red fruit, tall	*Rrtt* Red fruit, short
rT	*rrTT* Yellow fruit, tall	*rrTt* Yellow fruit, tall
rt	*rrTt* Yellow fruit, tall	*rrtt* Yellow fruit, short

8 a. mitosis (meiosis); b. recessive phenotype (dominant); c. mitosis (meiosis); d. wild allele (pleiotropic allele); e. law of assortment (law of segregation); f. Mendel (Morgan); g. characters (genes); h. Y chromosome (X).

9 a. *False* – The phenotype appears much more often in males than in females; b. *True*; c. *False* – This disease appears only if X chromosome is present; d. *False* – Daughters who receive one mutant X chromosome are heterozygous carriers; e. *True*; f. *True*.

10 1: Fruit flies lay many eggs and have large numbers of offspring (high fecundity); 2: The fruit fly life cycle is short and determined by temperature so it is possible to have results very quickly; 3: They have clear features and there are obvious differences between males and females; 4: They have very small size so little space is required (ease of culturing).

11 a. (*T*=tall, *t*=short, *S*=smooth, *s*=wrinkled)

	TS	***Ts***	***tS***	***ts***
TS	*TTSS* Tall smooth	*TTSs* Tall smooth	*TtSS* Tall smooth	*TtSs* Tall smooth
Ts	*TTSs* Tall smooth	*TTss* Tall wrinkled	*TtSs* Tall smooth	*Ttss* Tall wrinkled
tS	*TtSS* Tall smooth	*TtSs* Tall smooth	*ttSS* Short smooth	*ttSs* Short smooth
ts	*TtSs* Tall smooth	*Ttss* Tall wrinkled	*ttSs* Short smooth	*Ttss* Short wrinkled

The phenotypic ratios are as follows: 9 tall smooth; 3 tall wrinkled; 3 short smooth; 3 short wrinkled.

b. Case 1 (*T*=tongue-rolling and *t*=non-tongue-rolling):

	T	***t***
T	*TT* Tongue-roller	*Tt* Tongue-roller
t	*Tt* Tongue-roller	*Tt* Non tongue-roller

The genotypes and ratios are *1 TT : 2 Tt : 1 tt*.
Case 2

	T	***T***
t	*Tt* Tongue-roller	*Tt* Tongue-roller
t	*Tt* Tongue-roller	*Tt* Tongue-roller

All the children will be tongue-rollers.

c. Case 1
F_1 generation: *PpSs*, all wild-type.
PpSs X *PpSs*

	PS	***Ps***	***pS***	***ps***
PS	***PPSS***	***PPSs***	***PpSS***	***PpSs***
Ps	***PPSs***	***PPss***	***PpSs***	***Ppss***
pS	***PpSS***	***PpSs***	***ppSS***	***ppSs***
ps	***PpSs***	***Ppss***	***ppSs***	***ppss***

16 combinations of gametes in this dihybrid cross result in 9 different genotypes. F_2 in a ratio of 9 : 3 : 3 : 1 in phenotypes.
Case 2
The genotypes are: *PpSs, Ppss, ppSs, ppss*; the ratio is 1: 1: 1: 1; the phenotypes are: wild eye, long wing; wild eye, short wing; pink eye, long wing; pink eye, short wing; the ratio is 1: 1: 1: 1.

12 **Across**
1. CODOMINANCE, 4. GAMETE,
5. GENOTYPE, 7. MONOHYBRIDCROSS,
10. GENE, 12. ALLELE, 16. CHROMOSOME,
17. TESTCROSS, 18. PHENOTYPE,
19. PUNNETTSQUARE.

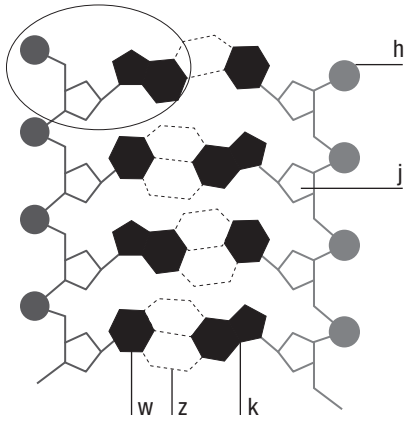
Down
2. DROSOPHILA, 3. RECESSIVE,
6. DIHYBRIDCROSS, 8. HETEROZYGOUS,
9. CHARACTER, 11. DOMINANT,
13. LINKAGEGROUP, 14. HOMOZYGOUS,
15. TRAIT.

13 1: genetic material; 2: bacterium; 3: virus; 4: bacteriophage; 5: DNA; 6: protein; 7: reproduce; 8: trace; 9: ^{32}P; 10: phosphorus; 11: ^{35}S; 12: sulfur; 13: phosphorus; 14: sulfur; 15: separate; 16: inject; 17: reproduce; 18: separately; 19: agitated; 20: dislodge; 21: bacterial cells; 22: spun; 23: heavier; 24: bottom; 25: pellet; 26: lighter; 27: supernatant; 28: pellet; 29: supernatant; 30: radioactivity; 31: sulfur; 32: supernatant;

33: did not enter; 34: phosphorus; 35: pellet; 36: entered; 37: DNA; 38: protein.

14 a: *True*; b: *False*; c: *True*; d: *False*; e: *True*; f: *False*; g: *True*; h: *False*; i: *True*; j: *True*.

15 a: Nucleotide;



b: Phosphate; c: Deoxyribose; d: W: thymine, K: adenine – Because there are only two hydrogen bonds between molecules; e: Z: cytosine – Because there are three hydrogen bonds between molecules; f: Phosphodiester bonds that are covalent bonds, between the third and fifth carbon atoms of adjacent sugar rings; g: The direction of the nucleotides in one strand is opposite to their direction in the other strand; the asymmetric ends of DNA strands are called 5´ (*five prime*) and 3´ (*three prime*) ends, with the 5' end having a terminal phosphate group and the 3' end a terminal hydroxyl group.

16 a-3, b-2, c-7, d-4, e-1, f-9, g-5, h-8, i-6.

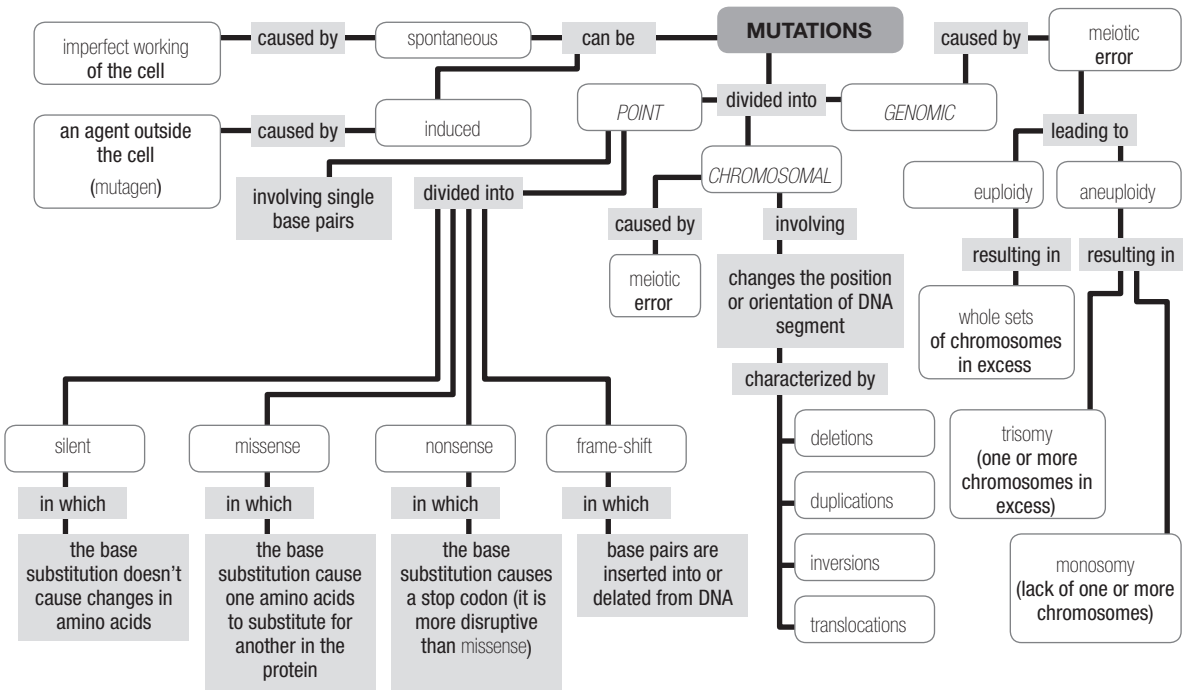
17 a: 3´-ATTCCG-5´; b: 3´-TAAGGC-5´; c: 3´-TGGAAT-5´; d: 3´-GCCTTA-5´; e: 3´-CGGAAT-5´.

18A 1: nucleus; 2: cell membrane; 3: cytoplasm; 4: DNA; 5: mRNA; 6: tRNA; 7: mRNA; 8: ribosome; 9: polypeptide.

18B a: Transcription; b: Translation; c: Transcription is the first stage of the expression of genes into proteins. In this enzymatic process RNA is synthesized using a DNA template in a process made up of three stages: initiation, elongation and termination, at the end of which the mRNA is moved out of the nucleus. The mRNA contains the instructions to make one single protein.

18C 1: cytoplasm; 2: tRNA; 3: enzyme; 4: ATP; 5: transcription; 6: mRNA; 7: first; 8: polypetide; 9: subunits; 10: ribosome; 11: start codon; 12: added; 13: 5´ → 3´; 14: stop; 15: codon; 16: protein; 17: released.

19



20

Influenza virus	HIV virus or AIDS
a. It enters by ***endocytosis***.	It binds to the host cell and then it enters through ***fusion*** of its envelope with the host's plasma membrane.
b. Once inside the virion is released by the fusion of the viral and vesicle membranes and the capside breaking.	After fusion, the virus releases RNA, its genetic material, into the host cell.
c. The virus carries its own enzyme to replicate its RNA genome; this ***RNA-dependent RNA polymerase enzyme*** uses RNA as a ***template***; the newly synthesized viral RNA strand is used as mRNA to make more copies of the viral genome by complementary base pairing.	Viral RNA uses ***reverse transcriptase*** to make complementary DNA (cDNA) then it degrades. Reverse transcriptase synthesizes the second DNA strand, cDNA enters the nucleus becoming integrated into the host chromosome and forms a provirus. When activated ***proviral DNA*** is transcribed to ***viral RNA*** and exported to the cytoplasm where it is translated into proteins.
d. New viruses assemble by ***budding*** and are released.	An assembled virus ***buds*** from plasma membrane.

21A a-lytic, b-lysogenic, c-bacterial cell, d-prophage.

1 A prophage is a molecule of viral DNA which has been integrated into the bacterial chromosome.

2 In the lytic cycle the virus reproduces immediately, killing the host cell; in the lysogenic cycle the viral DNA is integrated into the cell's genome and stays there for many replications until some conditions start a lytic cycle.

3 It usually happens when the host cell gets stressed or damaged, because while it is growing rapidly the phage exploits it to produce as much progeny as possible.

21B 1-c, 2-g, 3-d, 4-i, 5-f, 6-a, 7-h, 8-b, 9-e.

22 1-conjugation-A, 2-tranformation-C, 3-conjugation-B, 4-transduction-D.

23A 6-*lac* Operon, 5-Operator, 4-Promoter for *lac* operon, 1-Promoter for the regulatory gene, 3-Regulatory gene, 2-Structural loci.

23B Operon is a mechanism to control the transcription of proteins by which prokaryotes conserve energy and resources by making proteins only when they are needed.

24

Statement	The *lac* operon	The *trp* operon	Both
a		X	
b			X
c	X		
d	X		
e		X	
f		X	
g			X
h	X		
i			X
j	X		

25 a. Because in mammals one of the X chromosomes is inactivated in a random way in each cell. The cat is probably heterozygote and in some cells X^O allele is expressed, while in some other cells X^B is expressed.
b. No, because male cats have only a single X chromosome (XY) that does not undergo X-inactivation: coat color is determined by which allele is present on X, and they will be either entirely black or orange. Very rarely a male tortoiseshell cat is born, but these animals typically have an extra X chromosome (XXY) and are often sterile.
c. It is an example of whole-chromosome effect.

26

5'...	G	C	T	T	G	A	A	T	T	C	G	A	G	C	T	T	A	A	G	G	3'...
3'...	C	G	A	A	C	T	T	A	A	G	C	T	C	G	A	A	T	T	C	C	5'...

CAPITOLO 4

VERIFICA LE TUE CONOSCENZE

1 C
2 A
3 C
4 D
5 A
6 B
7 B
8 D
9 C
10 B
11 B
12 C
13 A
14 A
15 D

VERIFICA LE TUE ABILITÀ

16 A ambiente, B Griffith, C plasmide, D crossing-over, E breve
17 A regolatore, B induttore, C regolatrici, D promotore
18 A 6 miliardi, B telomeri, C regolatrici, D maturazione
19 B
20 C D

METTITI ALLA PROVA

33 B
34 C
35 D
36 B
37 A
38 D
39 C
40 A
41 C
42 C
43 D
44 C
45 C
46 B
47 C
48 B
49 E
50 D

Mutation of a bird virus results in human infection

- What was the new virus that killed a 3-year-old boy in Hong Kong in 1997?

The little boy had been infected with H5N1, a flu virus previously known to infect only chickens. The boy's day care provider had kept chicks for the children to play with, and several of the chicks died.

- Which other pandemics made it possible for an animal influenza virus to infect people with a single gene mutation?

The «Spanish flu» epidemic of 1918, which may have started with a single soldier, spread to Europe with U.S. troops fighting in World War I. The resulting pandemic led to 40 million deaths worldwide. Flu pandemics in 1957 and 1968 killed a million people each.

CAPITOLO 5

VERIFICA LE TUE CONOSCENZE

1 A
2 A
3 D
4 C
5 B
6 D
7 A
8 D
9 A
10 D
11 D
12 C

VERIFICA LE TUE ABILITÀ

13 A pool, B riproducono, C equilibrio
14 A fitness, B relativo, C frequenza, D caratteri
15 A morfologica, B biologica, C alleli, D riproduttivamente
16 A geografiche, B poliploidia, C vegetali
17 D E
18 A D
19 B D

METTITI ALLA PROVA

30 A
31 B
32 C
33 D
34 A
35 B
36 D
37 D
38 C
39 E
40 D
41 C
42 A
43 D

Sex stimulates speciation (among other things)

- May sexual selection also increase the rate at which new species form?

Evidence for this effect of sexual selection comes from comparing the number of species found in sister clades, that is, clades that share a common ancestor. Because they share a common ancestor, sister clades have been evolving independently from one another for the same length of time. The rate at which species have formed in the two clades can be estimated by comparing the number of species in them today.

- Why does sexual selection stimulate the divergence of a lineage into many species?

A likely reason is that random mutations result in different plumage elaborations in different parts of the range of a species.

CAPITOLO 6

VERIFICA LE TUE CONOSCENZE

1 D
2 B
3 A
4 C
5 B
6 C
7 A
8 D
9 C
10 D
11 A
12 B

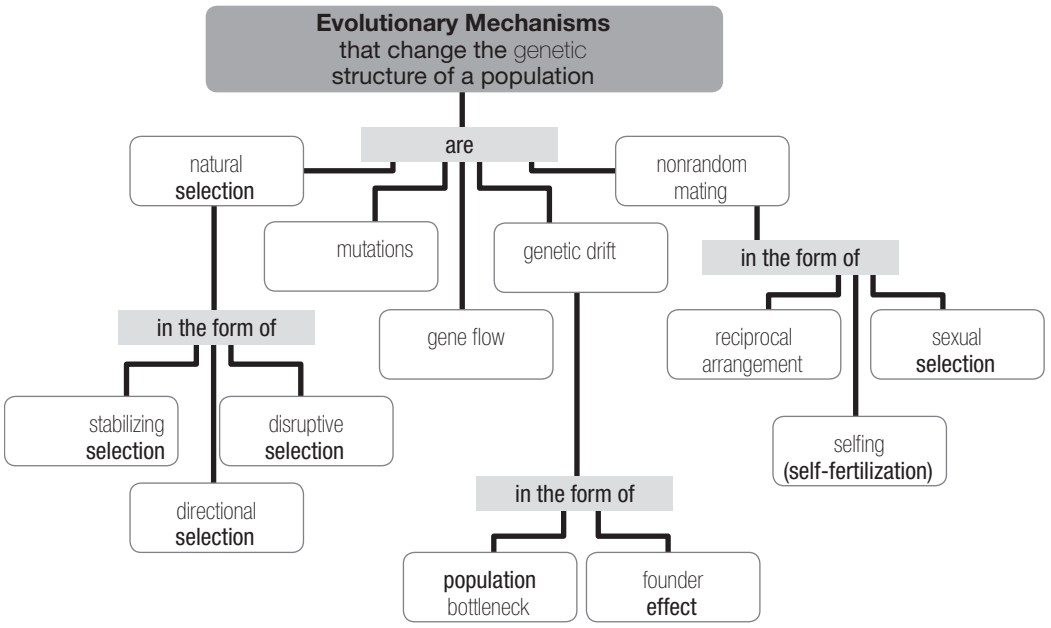
VERIFICA LE TUE ABILITÀ

13 A articolati, B conservato, C opponibile, D ruotare
14 A due milioni di anni, B cranico, C nascita
15 A olduvaiana, B sudoccidentale, C lame
16 B C
17 A C

METTITI ALLA PROVA

27 B
28 D
29 A
30 D
31 E
32 B
33 D

3A



Hobbits of Flores island

- How old are the fossil hominids discovered on Flores island?

Radioactive dating indicated that some of the fossil hominids were shockingly recent (a mere 18 000 years old).

How did the ancestral H. erectus colonize Flores?

- H. erectus colonized Flores during a period of glacial expansion, when sea levels were about 150 meters lower than they are today.

Biology in English (pages B141-B144)

1 a. Probably because most of the population in Tasmania is formed by the colonizers' descendants who mated with each other; the frequency in the population is different as a result of the limited sample of people.
b. It is the founder effect.
c. They can inform people about the probability to show Huntington's chorea. Now there are genetic tests that can be performed at any stage of development and it is possible to conduct genetic screening in the families that have someone who suffers from the disease.

2 a. $p^2 = 1/3250 = 0.00031$; $p = 0.018$
b. $q = 1 - p = 1 - 0.018 = 0.98$
c. $2pq = 0.035$ (probability of being a healthy carrier)

3B a. Because each of a large number of genes may mutate, and chromosomal rearrangements may change many genes at the same time.
b. When only a few individuals survive an event that causes large losses within a large population, thus producing random changes in allele frequencies.
c. Sexual selection.

4 1-generations, 2-cause, 3-species, 4-proteins, 5-Evolution, 6-offspring, 7-individuals, 8-reproduction, 9-population, 10-adapted, 11-traits, 12-phenotype, 13-genotype, 14-genes, 15-increasing, 16-produce, 17-frequencies, 18-environment, 19-reproductive, 20-probability.

5 a-Disruptive selection, b-Sexual selection (intersexual), c-Stabilizing selection, d-Sexual selection (intersexual), e-Sexual selection (intersexual), f-Disruptive selection, g-Directional selection, h-Sexual selection (intrasexual).

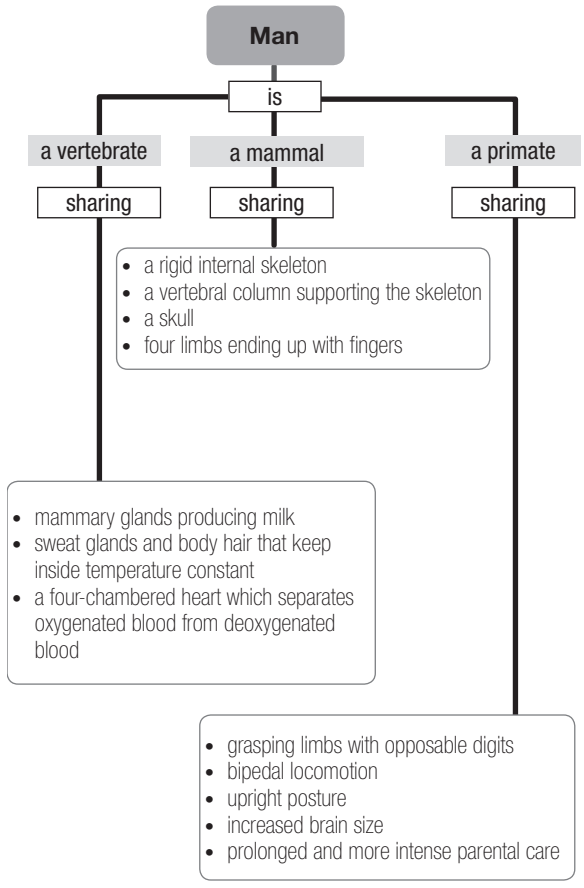
6A 1-False: Only a plaster replica, 2-True, 3-True, 4-False: Bipedalism preceded increased brain size, 5-False: Valgum knee, pelvis and leg bones, 6-True, 7-False: It was an astounding result, 8-False: It became a household name, 9-False: The name was taken from a song, 10-True.

6B a. It showed mixed and changing characters, so an evolution of *A. afarensis*.
b. Because they found no duplication.
c. By examining the pelvis and leg bones they found that they were almost identical in function to those of modern humans. They also found a valgus knee.

6C

Primitive features	Modern features
• Small skull capacity • Small brain • Small femoral head • Short femoral neck • Gorilla-like jaw	• Upright posture • Valgus knee • Function of pelvis and leg bones • Decreasing humerus-femur ratio • Shortening arm • Lengthening legs

7



8 a. The "Out-of-Africa Theory" (on the left) and the "Multiregional theory" (on the right).
b. The "Out-of-Africa Theory" postulates that humans similar to modern men left Africa 50-60,000 years ago to settle in the world and they replaced other more ancient hominids. The "Multiregional theory" upholds that modern men evolved in different populations in Asia and Europe but they did not originate different species because of interbreeding among groups.
c. Because mitochondria have a proper DNA different from the nuclear one and it is passed Down through the maternal line.