Biology in English

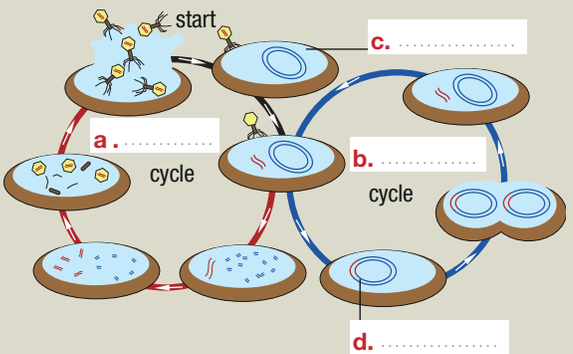
1 Viral infections

People are susceptible to many viral infections, two of the most important are influenza virus and human immunodeficiency virus (HIV). They are both single-stranded viruses, but their life cycles present two different infection strategies and genome replication. Compare the life cycles of these viruses.

Term of comparison	Influenza virus	HIV (or AIDS)
a. How the virus enters the cell		
b. How the virion is released in the cell		
c. How the viral genome is replicated		
d. How new viruses are produced		

2 Lytic and lysogenic cycle

A. Complete the diagram and answer the questions.



1. Give a definition of «d».
.....
.....
.....

2. Briefly explain the difference between «a» and «b».
.....
.....
.....

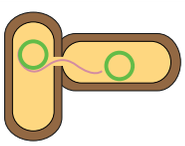
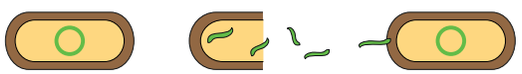
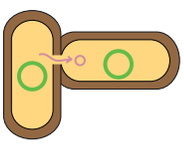
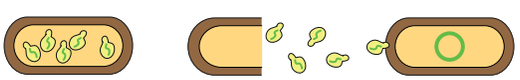
3. When does the prophage usually detach from the host chromosome to start a lytic cycle? Why?
.....
.....
.....

B. Put the sentences about the lytic cycle in the right order.

a. An early protein stimulates late gene transcription. ☐
b. Late genes also produce a protein for lysis. ☐
c. A virulent virus injects its DNA into a bacterium. ☐
d. The early genes are transcribed. ☐
e. New virions are released by lysis of the host cell. ☐
f. Other proteins stimulate viral genome replication. ☐
g. Viral promoter sequences attract host RNA polymerase. ☐
h. New viral capsid proteins are produced. ☐
i. Some viral proteins end up host transcription. ☐

3 Recombination

Look at the table: each picture represents one of the ways by which bacteria can recombine their genes. Write the right term in the first column and match it with the correct definition.

	Kind of recombination	Definition
	1.	**A.** During a viral lytic cycle, DNA fragments can be inserted into a capsid; the bacterial DNA can be injected into a new host cell when the new virion infects another bacterium.
	2.	**B.** It is the transfer of genetic material between bacterial cells by a bridge-like connection.
	3.	**C.** It is a gene transfer mediated by special genetic elements called plasmids.
	4.	**D.** It is the incorporation and expression of exogenous DNA from the surroundings and its intake through the cell membrane.

4 Antibiotic resistance

Alexander Fleming was a Scottish biologist who discovered the first antibiotic, penicillin. «When I woke up just after dawn on September 28, 1928, I certainly didn't plan to revolutionize all medicine by discovering the world's first antibiotic, or bacteria killer» he later said. Fleming was investigating the properties of some bacteria, he noticed that one culture was contaminated with a *Penicillum* fungus, and that the colonies of staphylococci that had surrounded it had been destroyed. He extracted the substance responsible for bacteria death and named it *penicillin*. Fleming's discovery was very important because it was possible to defeat many diseases like tubercolosis. However with the widespread use of antibiotics in these years, many bacteria have evolved mechanisms enabling them to grow in the presence of many antibiotics; for example some of them can produce penicillase, an enzyme which nullifies the effects of penicillin.
Answer the following questions.

a. What can cause antibiotic resistance in bacteria?

This event is generally very uncommon, but now many bacteria are antibiotic resistant; can you explain why?

b. Where are these resistance factors situated in bacteria?

c. Briefly describe the mechanism by which a bacterium can transfer antibiotic resistance to another.

5 Operons

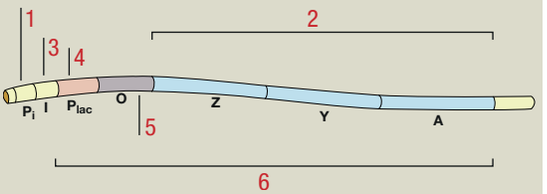
Read the following statements about operons as units of transcription in prokaryotes. Then tick the appropriate column in the table below to identify them as *lac*, *trp* operons or both.

Statement	The *lac* operon	The *trp* operon	Both
a. It is a repressible system.			
b. In this system the regulatory molecule functions by binding to the operator.			
c. Regulatory genes produce proteins whose function is to regulate the expression of other genes.			
d. The presence of an inducer keeps the repressor from binding to the operator and allows transcription.			
e. It controls the synthesis of tryptophan.			
f. The presence of a corepressor causes the repressor to bind to the operator and stops transcription.			
g. It controls a catabolic pathway.			
h. Its inducers are molecules of lactose.			
i. It is an example of negative control of transcription because the regulatory protein prevents transcription.			
j. It is an inducible system.			

6 The *lac* operon

A. Match the numbers in the diagram to the correct words choosing from the list below.

- ☐ *lac* Operon
- ☐ Operator
- ☐ Promoter for *lac* operon
- ☐ Promoter gene for the regulatory gene
- ☐ Regulatory gene
- ☐ Structural loci



B. What is the function of operons in bacteria?

7 Prokaryotic and eukaryotic genes and genomes

Say if the following characteristics belong to prokaryotes (P), eukaryotes (E) or to both of them (B).

Characteristic	P	E	B
a. Their genomes are smaller (in terms of haploid DNA content).			
b. In their genomes there are more points of control.			
c. Transcription and translation take place in two separate sites.			
d. They do not contain noncoding DNA sequences.			
e. They contain many repetitive sequences.			
f. Many protein-coding genes exist in only one copy in a haploid genome.			
g. They form gene families.			
h. The RNA polymerase needs other molecules to recognize the promoter.			
i. They have promoters.			
j. Their genome is always made up of a single chromosome.			
k. RNA splicing is not necessary.			
l. They contain transposons.			
m. They have stop codons.			
n. They have a terminator sequence.			
o. Their mature DNA has more stability and lasts longer.			

8 Repetitive DNA sequences

The genomes of eukaryotic model organisms contain numerous repetitive DNA sequences that do not code for polypeptides. Match the statements in column A with the ones in column B.

A		B
1. Highly repetitive sequences include	.....	a. properly termed genes coding for rRNA and tRNA.
2. Minisatellites are	.....	b. different from that of the rest of the genome.
3. The character of satellite sequences is	.....	c. which are very short sequences spread all over the genome.
4. Highly repetitive sequences are	.....	d. an RNA copy of themselves when they move about the genome.
5. Microsatellites are also called simple sequence units	.....	e. two types of sequences: minisatellites and microsatellites.
6. Moderately repetitive DNA sequences are	.....	f. to a new spot in the genome without replicating.
7. Transposons are always in a fixed position in the genome, but	.....	g. 10-40 base pairs long and are repeated up to several times.
8. DNA transposons move	.....	h. not represented in mRNA transcripts.
9. Retrotransposons make	.....	i. an inverted repeat sequence helping in the transposition process.
10. At the end of each DNA transposon there is	.....	j. can move from place to place into the genome being transposable elements.

a. What is the role of transposons in the cell?

b. What consequences can a transposon insertion at a new location have on a gene?

9 Tortoiseshell cats

In tortoiseshell cats fur color is determined by a gene with two alleles, black and orange, which is situated on X chromosome. Answer the questions.

a. Explain why the female cat has this patch of fur.

b. Do you think it is possible to have male cats with this kind of fur?

c. How can we define this kind of gene expression?

10 Restriction enzymes

EcoRI is a restriction enzyme that cuts DNA where it encounters the following sequence:

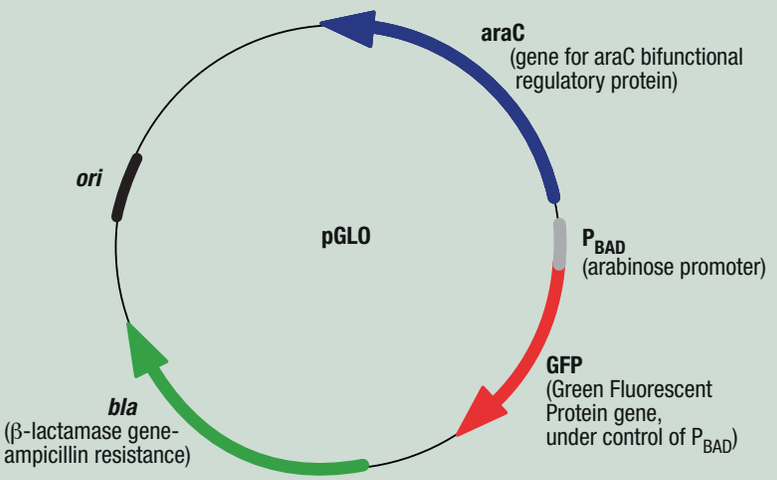
```
5' _ _ _ G      AATTC _ _ _ 3'
         |            |
3' _ _ _ CTTAA      G _ _ _ 5'
```

If EcoRI cut this sequence, how many and what fragments would be obtained?

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'...

11 Engineered plasmids

The pGLO plasmid is an engineered plasmid used as a vector for creating genetically modified bacteria. It contains arabinose operon and the ampicillin resistance gene. GFP is the gene for the green fluorescent protein. Answer the questions.



a. What does *ori* indicate?

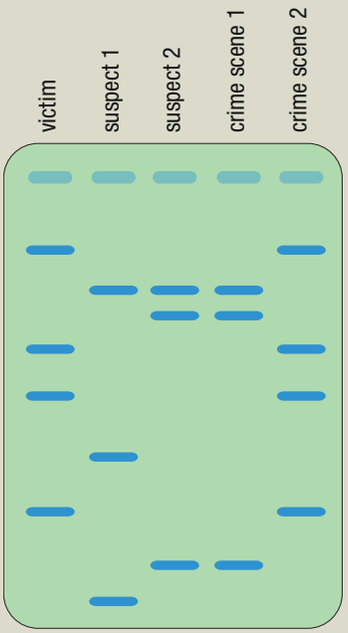
b. Why do we use a plasmid with an operon as a vector?

c. And what is the function of *bla*?

d. How can we identify the transformed bacteria?

12 Gel electrophoresis

Look at the picture showing the results of a gel electrophoresis of some DNA molecules. They were analyzed to discover the person responsible of a crime. Then answer the questions.



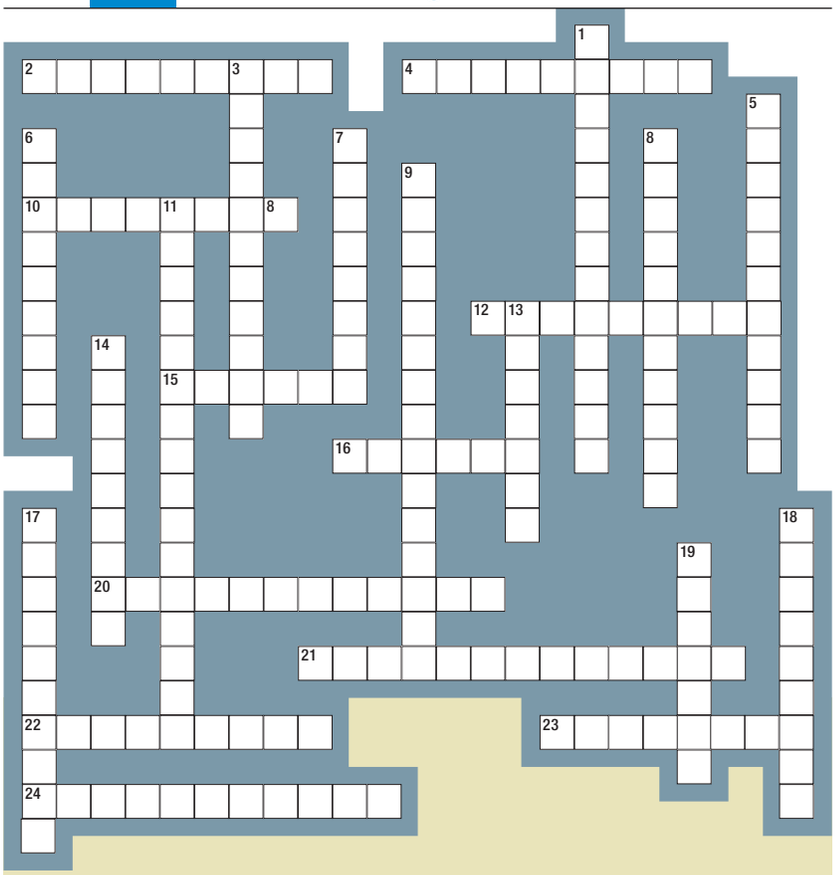
a. Each DNA sample was treated by a particular enzyme; what kind of enzyme was used?

b. Briefly describe the gel electrophoresis technique.

c. On the picture, sign the positive and negative poles of the electric field and circle the lightest fragment.

d. Who is the culprit and why?

13 Genes and the genome



Across

2. It is one of two methods of viral reproduction.
4. It is the combination of DNA and proteins that make up the contents of the nucleus of a cell.
10. It is an adaptor molecule composed of RNA with the anticodon.
12. It is the process of programmed cell death.
15. It is a functioning unit of genomic DNA containing a cluster of genes under the control of a single regulatory signal or promoter.
16. It is any nucleotide sequence within a gene that is removed by RNA splicing to generate the final mature RNA product of a gene.
20. It is the process by which DNA is transferred from one bacterium to another by a virus.
21. It is the enzyme that synthesizes cDNA from mRNA in HIV.
22. It binds to the operon.
23. It is a region of repetitive DNA sequences at the end of a chromosome.
24. Genes that can jump.

Down

1. It is a virus that infects bacteria.
3. They are the monomers of nucleic acids.
5. They are very large protein complexes inside all eukaryotes and archaea, and in some bacteria which can degrade unneeded or damaged proteins
6. They are changes in a genomic sequence.
7. It is a mutation in which a part of a chromosome or a sequence of DNA is missing.
8. They are nonfunctional genes.
9. It is the process by which a less specialized cell becomes a more specialized cell type.
11. It is the mechanism by which DNA is replicated.
13. Together with pyrimidines they make up the two groups of nitrogenous bases.
14. Short molecules of single-stranded DNA that are formed on the lagging strand during DNA replication called Okazaki.
17. The genetic code is called so due to redundancy.
18. It is a DNA sequence capable of binding transcription regulation factors termed repressors so as RNA polymerase is prevented from initiating transcription.
19. It is a type of polysomy in which there are three copies, instead of the normal two, of a particular chromosome.