AP Biology
2000 Student Samples

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3D1

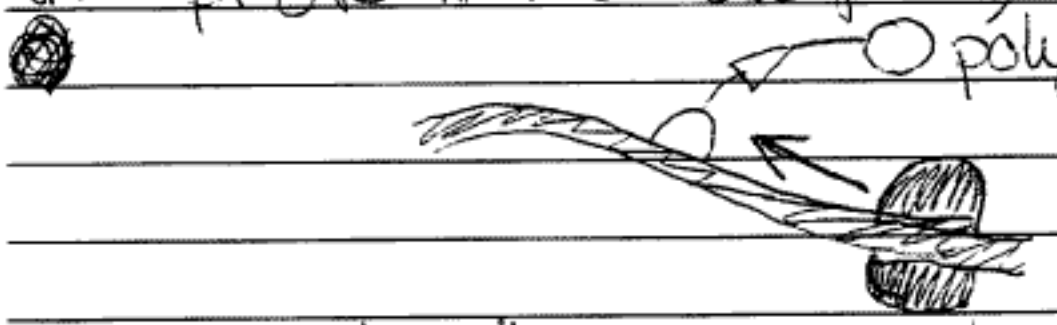
3. Information transfer is fundamental to all living organisms. For **two** of the following examples, explain in detail how the transfer of information is accomplished.

   a) The genetic material in one eukaryotic cell is copied and distributed to two identical daughter cells

   ⓑ A gene in a eukaryotic cell is transcribed and translated to produce a protein

   ⓒ The genetic material from one bacterial cell enters another via transformation, transduction, **or** conjugation

ⓑ The genetic information in one eukaryotic cell is copied by starting with the DNA strand. RNA then transform the DNA code and use a stop codon to complete this process. The mRNA then travel outside of the cytoplasm and form long ribbons of information. As proteins come to the messenger RNA they slide across with an amino acid - forming a polypeptide chain which breaks off and then re-enters to form the protein. (See diagram)

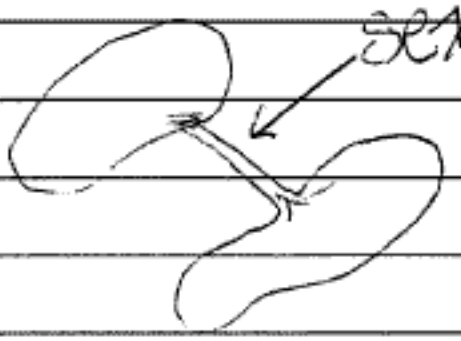


c) Bacterial cells may tranfer genetic information via conjugation. In this method the two bacterial cells must connect by means of a sex pili which serves as a bridge for information. The donating bacterium copies its genetic information in part, using mRNA (see figure 1)

GO ON TO THE NEXT PAGE

ADDITIONAL PAGE FOR ANSWERING QUESTION 3

figure 1: AGC CUG ACG : DNA
TCG GAC TGC : RNA
Then the information travels down the sex pilus into the receiving bacterium who processes it into their genetic material.



GO ON TO THE NEXT PAGE

3B1

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a) The replication of DNA, known as Replication is vital to the exact transfer of DNA from a Mother cell to daughter cells. The process begins with the enzyme DNA Polymerase. DNA Polymerase attatches to the DNA molecule and uncoils it. The two uncoiled parts then have matching base pairs added: "A" to "T" and "C" to "G". ~~Enzyme~~ DNA Polymerase moves along, attaching individual bases 3' to 5' along the entire molecule. Because only A can pair with T, and C with G, the integrity of the molecules are maintained. Now, there are two sister chromatids linked together by a centromere. The sister chromatids are Identical. The cell separates these chromatids by the process of Mitosis. Spindle fibres help to move the DNA to opposite sides of the cell. Cytokinesis occurs, and there are two daughter cells with Identical DNA now

GO ON TO THE NEXT PAGE

ADDITIONAL PAGE FOR ANSWERING QUESTION 3

a) The process of Transcription begins with the molecule of DNA, and RNA Polymerase. RNA Polymerase attaches to the DNA and on initiator blocks and begins Unwinding the DNA and attaching RNA Base pairs to it. A & T, C to G. The RNA molecule is then processed and has parts added or removed, and then leaves the nucleus. At the point, the two parts of a Ribosome attach to the mRNA & tRNA, which has RNA and a Specific Amino acid, is attached to the mRNA at intervals of 3 bases. The codon on the mRNA codes for a Specific anticodon on the tRNA, which has a specific Amino acid. the Amino acids are linked together in sequence until a protein is formed. This process is known as Translation.

GO ON TO THE NEXT PAGE

3A1

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a) During the S phase of the cell cycle, the DNA of a cell is copied. This occurs with the help of many enzymes. Primase forms an RNA primer at the location where duplication is to begin. Helicase unwinds the double helix structure exposing the complimentary strands to DNA polymerase which lays down complementary base pairs using the ~~other~~ a strand of the original DNA as a template. Replication always occurs from the 5' to 3' direction of the strand. In the lagging strand (the strand not naturally going in the 5' to 3' direction) fragments of DNA are replicated from 5' to 3' and then welded together with the enzyme ligase.

Once the DNA has been replicated, it enters the G_2 phase of the cell cycle during which ~~replicates~~ the microtubules needed for mitosis are formed. During the first phase of mitosis (prophase) the DNA condenses into chromosomes by wrapping about proteins called histones. During metaphase, the chromosomes line up in the center of the cell. During anaphase, the sister chromatids (identicle parts of homologous chromosomes) separate and begin moving ~~th~~ to polar ends of the cell. During telophase the chromosomes unwind and

GO ON TO THE NEXT PAGE

ADDITIONAL PAGE FOR ANSWERING QUESTION 3

the nuclear envelope reforms. Cytokinesis occurs at this time, dividing up the cytoplasm between to two new daughter cells. The daughter cells separature from each other when a cleavage furrow forms and the two cells are "pinched off" creating two self-contained cells.

b) Transcription (making of RNA) begins when promoting factors bind to the TATA box of the DNA and bind to RNA polymerase (the enzyme that assembles RNA). RNA polymerase lays down complementary base pairs until it reaches a termination sequence in the DNA. Introns (genes that don't code for amino acids) are removed, and exons (the genes that do code for amino acids) are ligated together. A 5' prime cap and a poly A' tail are added to protect the newly transcripted mRNA in the cytoplasm. Once in the cytoplasm, a small ribosomal subunit, a transfer RNA, and the larger ribosomal unit bind to the messenger RNA. tRNA's bearing amino acids match their 3 base-pair anticodon to each complementary mRNA codon and the amino acid binds to the one in the P site of the ribosome. The polypeptide continues to elongate as more amino acids enter the A site and form peptide bonds, this continues until a termination sequence is reached and now the polypeptide is completed.

GO ON TO THE NEXT PAGE

3C1

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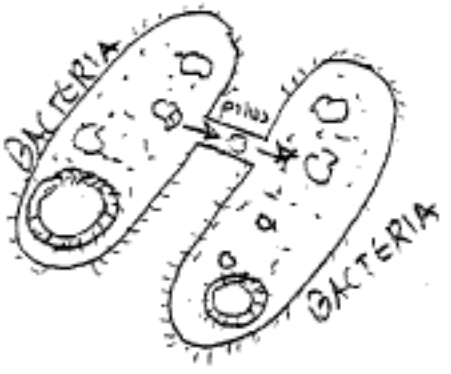
A bacterial cell can pass information on to another cell by way of a process called conjugation. In conjugation a pilus is formed between two bacteria and copies of one DNA is passed over to the other. It is via this sort of "sexual" conjugation that resistance to antibodies can be passed among bacteria. It of couse is not sexual reproduction but when observed it resembles it. (see diagram) A strain of E. coli has been found to be resistant to all known antibiotics because of this conjugation mechanism. One mutation in a bacteria that enables it to withstand antibiotics will be passed onto the next and soon the bacteria will be immune.

In mitosis a cell splits to form two daughter cells each with an identical copy of the parent cell genetic material. The cell chromosomes copy and line up in the middle of the cell then spindle fibers form and break the sister chromatids and take them to the centrioles on the sides of the cell. Then the cell cleaves in the middle

Conjugation:



GO ON TO THE NEXT PAGE

ADDITIONAL PAGE FOR ANSWERING QUESTION 3

encdsing both sets of chromosomes in two different daughter cells. This division is an integral part of life on earth. Cells are constantly spliting into new cells regenerating, and passing on their specific genetic material to the next cells. The genetic material is copied by the ribosomes in varying forms of messenger, transfer, and transcription RNA. Mitosis is a complex process but it perpetuate the biomass on earth.

GO ON TO THE NEXT PAGE