Sample of biology exam questions with explanations

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Insulin injections are necessary for some diabetic patients because.

(A) They have increased glucose levels in their blood.
(B) They are obese
(C) They have a high percentage of glycogen stored in the liver
(D) They have difficulty digesting carbohydrates and proteins in the intestines

Insulin functions to decrease the blood glucose levels when they are too high, such as after a meal. In diabetic patients, their bodies do not produce enough insulin, either because their beta cells do not produce enough, or because their bodies cannot take up the insulin they produce. This leads to insulin resistance in which their bodies begin a vicious cycle of producing less and less insulin for metabolism. In Type 2 diabetes, this can usually be controlled with proper diet and exercise. In Type 1 diabetes, generally nothing can be done except injecting synthetic insulin, or pancreatic transplants. These transplants can be risky and the demand for transplants is higher than the supply.

Generally, people who are obese tend to be diabetic. However, that does not mean that they always are, nor are they destined to become, diabetic.

Glycogen is stored in the liver to produce glucose when the body needs more of it. The enzyme Glucagon breaks down the glycogen and releases it into the bloodstream as glucose. Having large amounts of glycogen is a result of insulin working properly in the body, the opposite of needing injections.

An inability to digest carbohydrates and proteins would lead the body to have less glucose to utilize for metabolism. Injecting more insulin would not make more glucose available. The hormones released from the islets of Langerhans are responsible for converting carbohydrates to glucose, not insulin. The person would still have diabetes, but lack of insulin is not the reason. Now, we're ready to choose the correct answer. Insulin injections are necessary for some diabetic patients because? They have increased glucose levels in their blood.

Which of the following might be the cause of diabetes mellitus?

(A) All of the answers are correct.
(B) Decrease in insulin secretion
(C) Damage to the beta cells in the Langerhans islets
(D) Disturbance in the metabolism of carbohydrates and lipids

There can be several causes of diabetes mellitus. Insulin resistance, caused by poor diet and lack of exercise, makes insulin receptors in the body's cells less responsive to insulin. This produces a

vicious cycle in which the beta cells in the islets of Langerhans produce more and more insulin to compensate in an attempt to keep glucose levels balanced. Paradoxically, the more insulin that is produced, the more insulin is needed. Eventually the entire feedback loop shuts down and the body no longer produces insulin in sufficient quantities. This is called Type 2 diabetes.

If beta cells become damaged, or have never worked properly from birth, insulin will not be secreted for use in the body. Type 1 diabetes will result. Unlike Type 2 diabetes, changing diet and exercising more will not fix the damage. Without a risky transplant operation, or the use of experimental stem-cell therapy, the person will have a chronic condition that can result in serious nerve and organ damage if not properly controlled with insulin injections.

A disturbance in the way a person metabolizes carbohydrates and lipids can also cause diabetes. If their endocrine system produces too much glucose from food, their beta cells may not be able to compensate for the extra glucose, and Type 2 diabetes can result. Conversely, if their insulin does not utilize the enzyme glucagon properly, not enough glycogen will be stored in the liver for release when the body needs in. Now, we're ready to choose the correct answer. Which of the following might be the cause of diabetes mellitus? All of the answers are correct.

How many chromosomes are contained within a single human body (somatic) cell?

(A) 46 chromosomes
(B) 23 chromosomes
(C) 84 chromosomes
(D) 42 chromosomes
(E) 12 chromosomes

Each cell in your body contains a membrane-bound organelle called a nucleus. Inside of that nucleus resides all the genetic information that makes you who you are. Cells arranged in this way are called 'eukaryotic' and are a relatively recent addition to life on this planet.

In humans, there are 46 chromosomes residing in the nucleus, in 23 pairs. Remember that distinction as it can get confusing. 44 of those chromosomes code for attributes like height, eye-color, and whether you can roll your tongue into a 'U' or not. Two of the chromosomes decide whether you were born female or male. Two X chromosomes (XX) means you were born genetically (or genotypically) female and are fortunate to have a backup of your sex chromosomes. The XY combination means you were born genotypically male, and you do not have backup DNA in the other chromosome. How your body expresses these genes is referred to as your phenotype.

The human genome is 3 billon base pairs long, written with amino acids with the designations A,T,C, and G. Because we hold 2 copies of each of each molecule, our cells are diploid (di- meaning 2), which results in 6 billion base pairs in each nucleus. Stretching out all of the chromosomes in a single cell would lead to a chain 2 meters long. That is as tall as the basketball player, Michael Jordan.

Which of the following is the correct order of organization of the eukaryotic chromosome?

(A) DNA double helix ⟶ nucleosome ⟶ chromatin ⟶ chromosome
(B) Nucleosome ⟶ chromatin ⟶ DNA double helix ⟶ chromosome
(C) Chromatin ⟶ DNA double helix ⟶ nucleosome ⟶ chromosome
(D) DNA double helix ⟶ chromatin ⟶ nucleosome ⟶ chromosome

Base pairs in the human genome are tightly bundled it the DNA double helix and then undergo several layers of remarkable compaction to fit inside of one haploid chromosome. The double helix is wrapped around a protein called a histone which serves as a spoke on a wheel, or the innertube of a roll of toilet paper. Groups of 8 of these histones further wrap together to increase their compaction into a new structure. This compacted structure is called a nucleosome.

The nucleosome is further coiled into a structure called a chromatin that resembles a coiled spring. If a cell is not dividing, but rather performing its function in protein synthesis, the coiling usually stops at this point and the nucleosomes float in the nucleus without further compaction. It is not possible to tell what chromosome the nucleosome will ultimately form at this point. All of the nucleosomes are still tightly packed and dense, but not at the level needed for cell division.

When eukaryotic cells divide, a further layer of compaction takes place. The nucleosomes coil up into the characteristic X shape of chromosomes. When the cell begins to divide, the chromosomes line up, with each pair facing the other in resembling partners in a dance. This illustrates their diploid characteristics, showing 2 chromosomes not just one.