**Mutations 2**

Script

Instructions: Advance the PowerPoint slides at every new paragraph and anywhere you see “/”

[1] Mutations, part 2

[2] You have learned that individual nucleotide bases (which are like letters) / make up the codons / (which are like words) / that make up the genes / (which are like chapters) / that make up chromosomes / (which are like individual books) / which all together make up all your DNA / (and are like a series of books)

[3] You have also learned that mistakes—which are called Mutations—can happen during the process of cell division. Many mistakes are caught and corrected, but some are not. / Mistakes that happen during the replication of regular body cells can result in diseases such as cancer / but cannot be passed on to offspring. / Mutations that happen to reproductive cells / can be passed on to offspring. If a mutation in reproductive cells is bad enough, the offspring may not develop properly or may die early.

[4] Mutations can affect a single gene /or an entire chromosome.

[5] We’ll talk about 2 kinds of mutation that can affect a single gene / and four kinds of mutations that can affect entire chromosomes.

[6] The two that affect single genes are sequence mutations and frameshift mutations.

[7] A sequence mutation—sometimes called a point mutation—happens when one nucleotide base is substituted for another. / Kind of like when a “v” is substituted for the “c” in pancake.

As this strand of DNA was copied, this “A” / was replaced by a “C” /.

[8] Since A always joins with T and C always joins with G,

[9] the new “C” would have to join with a “G”. In this way both bases are replaced by others.

[10] The second kind of mutation that affects a single gene is a frameshift mutation, / which happens when an extra base is inserted / (kind of like when this extra “a” is added to the word pancake) / or when a base is deleted (/ kind of like when the “c” is deleted from the word pancake). / When an extra letter is added, / it pushes all the letters after it further to the right. / When a letter is deleted, all the letters after it move to the left.

[11] Here is an illustration of a frameshift deletion. / Figure 1 represents the original strand of DNA. / Figure 2 shows that while the DNA was being copied, an “A” was left out by mistake, leaving a gap in the sequence. / Everything to the right of the missing “A” / shifts to the left to fill the gap. / Figure 3 shows the new strand of DNA. / The section to the left of where the deletion occurred is just the same as it was before. / The gap left by the deletion has been filled by shifting the rest of the bases to the left.

[12] The new strand of DNA is one base shorter than the original strand. Because many of the base pairs shifted to the left, the groups of three are different now. / Notice that the sequence used to be C, T, A. But now it is T, A, G. Since each sequence of three bases carries information, the information carried by the sequence of three may be damaged or lost as the sequence changes.

[13] Something similar happens in a frameshift insertion. / This time, an extra base is inserted by mistake between two other bases, / making the new strand of DNA longer than the original one was. / In the new strand, / the newly inserted base pair / causes all the rest of the bases to shift to the right.

[14] Because of the newly inserted base pair, the groups of three are no longer the same. / The sequence TGT in the original DNA strand / is now TTG. / What used to be TGG / becomes TTG. / And AAT / is now GAA.

[15] Remember that three individual bases in a row make up a codon. The specific order in which the bases and codons appear has meaning. If the codons get rearranged, the meaning is no longer correct.

[16] To help you understand a frameshift mutation, look at this example. Notice that this sentence is made up of three-letter words. You can think of each word as a codon. Like a codon, each three-letter word has meaning. / Watch what happens to the groups of three letters when the “E” is deleted from the word “the.” As the rest of the letters shift to the left, the groups of letters are rearranged, and the meaning of the sentence is lost.

[17] The same thing happens in a frameshift mutation. As individual base pairs are added or deleted, all the rest of the base pairs shift to the right or to the left. Codons are rearranged, and the meaning of the information they carry is changed.

[18] Before we move on, let’s review the two kinds of mutations that affect a single gene. / A sequence mutation or point mutation changes the gene at a single point in the sequence by substituting one base for another, but it doesn’t change the number of base pairs in the gene. / A frameshift mutation adds or loses a base pair, shifting the rest of the bases either to the right or the left.

[19] The four kinds of mutations that can affect entire chromosomes are quick and easy to explain. They are: gene duplication…

[20]Gene deletion…

[21] Gene inversion…

[22] And translocation

[23] Sometimes instead of a gene being copied once like it should be / it gets duplicated twice. This is called gene duplication.

[24] Or an entire gene can be deleted

[25] and not appear at all in the new chromosome. This is called gene deletion.

[26] In gene inversion, a whole gene can be flipped around and inserted into the new chromosome backwards. / Notice how the “D, E, F” gene gets turned completely around so that it’s in the opposite order / “F, E, D” in the new chromosome.

[27] Finally, in translocation, a segment of DNA from one chromosome is moved to another chromosome. Here you see that a piece of chromosome 1 / ends up on chromosome 2 and a piece of chromosome 2 / ends up on chromosome 1.

[28] Any of the mutations we have discussed can happen during either mitosis or meiosis. / Only mutations that happen during meiosis are inherited by offspring. / Mistakes that happen during mitosis cannot be passed on the next generation.

[29] How serious the results of a mutation are depends on / the type of mutation, / the number of genes involved / and the location of the mutation.

[30] A mutated gene can produce a protein that doesn’t function properly any more. / Or the cell could lose its ability to make a certain protein at all! / Some mutations can cause genetic disorders.

[31] For example, a translocation between chromosome 9 and 22 is called a Philadelphia chromosome and is associated with various kinds of leukemia.

[32] Other examples of genetic disorders include Cystic Fibrosis, certain cancers, and Sickle Cell Disease

[33]Rarely, if ever, is a mutation beneficial. The mutation that causes Sickle Cell Disease does allow people to combat Malaria. So someone who lives in a place where Malaria is common might be benefitted in the fight against Malaria, but he or she would still have to deal with the Sickle Cell Disease.

[34] It’s important to understand mutations because of the important role they are supposed to play in the theory of evolution. / To understand the theory of evolution and whether mutations are capable of playing the role suggested for them, watch the series of videos called Origins 101.