5.8 Wei and Noé Discuss Meiosis

Wei and Noé (pronounced way and no way) are two biology students who—like all high school students—love discussing biology! Today Wei and Noé are discussing one of life's many wonders—the process of meiosis. We find our two scholars in the biology room…Wei is looking over the biology book as Noé walks up.

Noé: Hey, Wei! What are you reading?

Wei: *[looks up from the biology book]* Hey, Noé…just looking over our reading assignment. I can't believe all of the processes that we need to learn for biology class. First there were photosynthesis and respiration, then DNA replication, protein synthesis, mitosis…and now meiosis!!!

Noé: I know…well, that's life! It's a complicated business, being alive. So…do you understand the meiotic process?

Wei: Well enough, I think. It's pretty much the same as mitosis—just twice! So that makes it a little easier to remember.

Noé: What I think is interesting is how the cell divides twice rather than once, but the DNA still only replicates once during the cell cycle—like for mitosis. The result is something quite different than what we find in mitosis.

Wei: How so, Noé?

Noé: Well…the DNA replicates once, right? But then in Mitosis the chromosomes and the cell only divide once. So we double the DNA and one half goes to one cell and the other half goes to the second cell ... we end up with the same thing we started with…but two cells. In a human—the result is two cells, each with 46 chromosomes…identical (genetically) to the original.

Wei: OK…but with meiosis, the cell divides twice even thought the DNA replication occurrs only once. So, instead of making two cells, we end up with four cells. By the end of this process, each one of the four cells only has one-half the DNA of the original cell. Right?

Noé: Exactly! So for humans, a cell going through meiosis produces 4 daughter cells, each with only 23 chromosomes.

Wei: Right!!! And to make it even more interesting, all four of those daughter cells are different genetic mixes of information—they are all genetically different!

Noé: No way!

Wei: Way!

Noé: But how does that happen, Wei? The process does not seem that different from mitosis…and those cells end up being genetically the same.

Wei: Great question my curious friend! This happens because of synapsis!

Noé: Synapsis???! What's that?

Wei: Synapsis is the step at the beginning of meiosis in which homologous chromosomes pair up.

Noé: "Homologous chromosomes"…I know I should know what those are. What are they?

Wei: You know that we have 46 chromosomes. But they occur in pairs! That's because we each have one of each chromosome from each parent. Our largest chromosome is called the #1 chromosome (yeah, I know…really innovative naming system). You have two #1 chromosomes—one from your mom and one from your dad—those two #1 chromosomes are homologous. During synapsis, all of your homologous chromosomes line up.

Noé: *[excited]* Now I remember! And during synapsis, the homologous chromosomes swap chunks of DNA…kind of like shuffling a deck of cards. This mixes up the DNA and adds diversity. By the time the chromosomes separate, the cells are all genetically different.

Wei: But that brings up a question, Noé. Why would we—or any critter—WANT a cell with only one-half the normal amount of DNA? I mean, it seems that having less than the normal DNA would be a problem for the cell.

Noé: Good thinking, Wei! And, normally, you would be right. A cell with too little or too much DNA is in for trouble!! But meiosis results in a special type of cell—one with a very specific purpose.

Wei: I can't imagine how 1/2 the normal amount of DNA would be useful…

Noé: I'll give you a hint. When would you put two half-cells together to make a complete cell?

Wei: Is this another one of your dumb biology jokes? 'Cause they are not funny!

Noé: First of all, my biology jokes are hilarious! And, no, this isn't a joke…it's a hint.

Wei: OK, OK…let me think…two cells combining to form one normal cell. So for humans, two cells, each with 23 chromosomes would combine to form one cell with the normal 46 chromosomes. *[thinking hard]* Hmmm…*[excited]* I know!!!! That sounds like fertilization! The combination of an egg cell and a sperm cell to

form a fertilized egg!!!

Noé: Way to go, Wei! So meiosis produces the reproductive cells—the ones that need to have only one-half the normal DNA.

Wei: So when an egg cell with 23 chromosomes combines with a sperm cell with 23 chromosomes, you get a fertilized egg with 46 chromosomes—the correct number for us humans!

Noé: See, Wei…that's not so hard after all. And, like the rest of biology, it really is quite fun!! Oh… _____ (teacher's name) is ready to get started! *[Wei and Noé turn to the front of the room].*

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