AP Lab #7 - Cell Division: Mitosis and Meiosis

30/10/14

Prelab

1. How is cell division important to a single-celled organism?

   Cell division is very important for a single-celled organism because it is the process by which individuals reproduce.

2. What must happen to ensure successful cell division?

   To ensure successful cell division, the DNA must be replicated so the daughter cells have identical genetic information as the parent cell. The actual division process is necessary for successful division as well.

3. How does the genetic information in one of your body cells compare to that found in other body cells?

   The genetic information in one body cell is the same as that found in other body cells.

4. What are some advantages of asexual reproduction in plants?

   Asexual reproduction only requires one parent, meaning the plant could reproduce whether it is fertilized or not. Also, the process can be done much more quickly. If the environment is stable and the parent thrives, asexual reproduction can be advantageous as well.

5. Why is it important for DNA to be replicated prior to cell division?

   If the genetic info were not to be replicated before cell division, then the daughter cells would have very unequal distributions of DNA. One cell may have none, while the other cell has double. Either way, the cells can not be successful, since the information is meant to be conserved.

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6. How do chromosomes move inside a cell during cell division?

During cell division, chromosomes line up at the metaphase plate and are moved and pulled apart by microtubules (spindle).

7. How is the cell cycle controlled? What would happen if the control were defective?

If the cell cycle was not regulated and the control were defective, cells would undergo constant uncontrolled division. checkpoints after certain phases of the cell cycle help to regulate it. Cyclins and cyclin-dependent kinases (cdks) work together to signal the entering or exiting of the cell from certain phases.

8. What are cyclins and cyclin-dependent kinases? What do these proteins do in a cell?

Cyclins are activating proteins that bind to cyclin-dependent kinases and signal the cell to pass to the next phase in the cell cycle. When cyclin degrades, the exit out of an phase is signalled.

9. How are normal cells and cancer cells different from each other?

Normal cells can reproduce normally, stop reproducing, respond to signals, remain in one location, become specialized, and carry out normal designated functions. Cancer cells will reproduce uncontrollably, don't communicate, spread to other areas, and go unchecked.

10. What are the main causes of cancer?

Cancer is caused principally by abnormal properties in cells that enable them to grow and spread excessively. This is usually a result of mutations that occur because of chemicals, radiation, ultraviolet light, and errors in chromosome replication.

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11. What goes wrong during the cell cycle in cancer cells?

In cancer cells, the mechanisms and signalling processes that regulate the cell cycle do not function properly. The systems that normally stop cells from proceeding through the cycle are not activated.

12. What makes some genes responsible for an increased risk of certain cancers?

Usually random and unlucky mutations or chemicals cause damage to a gene on a chromosome that can increase the risk of cancers. Certain mutated genes are more likely to cause cancer than others.

13. Do you think that the chromosomes might be different between normal and cancer cells?

The chromosomes between normal and cancer cells probably don't differentiate, although certain genes on the chromosomes may differ from one another due to mutations.

Data

Part 2

Interphase Prophase Metaphase Anaphase Telophase

Stage of Cell Cycle	Number of cells in stage	% in stage
Interphase	135	87.7%
Prophase	9	5.8%
Metaphase	4	2.6%
Anaphase	3	1.95%
Telophase	3	1.95%

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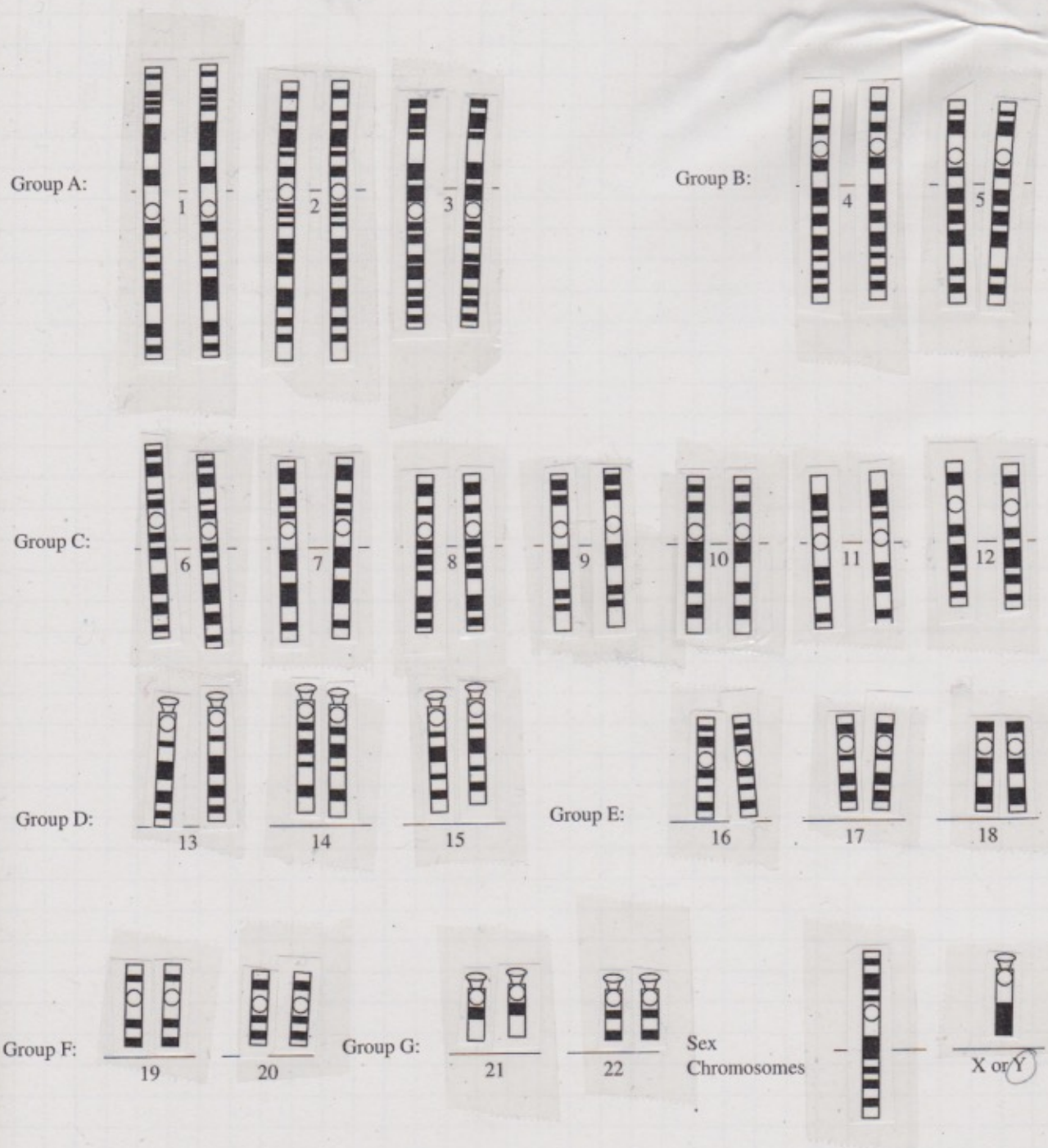
Denver System Worksheet

Karyotype Sheet # 3

How many chromosomes are present? 46



normal male karyotype

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Postlab

1. If a cell contains a set of ~~diploid~~ duplicated chromosomes, does it contain any more genetic info than the cell before the chromosomes were duplicated?

   The cell does not contain any more genetic info, it has the same genetic information twice, so to speak.

2. What is the significance of the fact that chromosomes condense before they are moved?

   Chromosomes condense so they can be more easily moved and organized without entangling or breaking.

3. How are the chromosomes copies, called sister chromatids, separated from each other?

   They are separated by the spindle fibers that attach to kinetochores and pull them apart after sister chromatid cohesion ceases.

4. What would happen if the sister chromatids failed to separate?

   There would be unequal distribution of chromosomes in the daughter cells. The cells would not be genetically identical.

5. From your observations, what went wrong in Henrietta Lacks's cervical cancer cells that made them cancerous?

   Something must have gone wrong with the regulation of the cell cycle. Henrietta Lacks's cervical cells and immune system was weakened due to the human papilloma virus infection, which increased her risk of contracting cervical cancer. The HPV can produce proteins that lead to cancer if it combines with the DNA of the host cell and changes genetic information.

6. How does infection with HPV increase risk of cervical cancer?

   The HPV can cause a defective DNA sequence, leading to cancerous cells.

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7. What happens in a normal cell if the DNA has mutations?

If the DNA has mutations these will be transferred to daughter cells as well, leading to continuation of the defect in some cases. If the DNA in a normal cell has mutations, the cell may malfunction and cause disorders for the organism. sometimes mutations have no effect.

8. What would happen if cells with mutated DNA replicated?

If cells with mutated DNA replicated, then the wrong information would spread to daughter cells and continue spreading. The functions and traits of an organism may change and cancer could also be a result. There are also mechanisms that can fix mistakes though.

9. How do cells monitor DNA integrity?

In the cell cycle, DNA integrity is regulated at checkpoints. The G_1 checkpoint is important for allowing a cell to proceed, since the cell will usually divide after receiving a "go" signal at G_1.

10. How are the chromosomes different in the cancer cells compared to normal cells?

In cancer cells chromosomes may contain different genetic information and be structurally rearranged. There may also be abnormal numbers of chromosomes in ~~normal~~ cancer cells.

11. How could these differences lead to cancer?

These differences can be detrimental to the cell because it may not stop dividing due to the abnormalities in the chromosomes. Problems can occur with growth and development of the cells.

12. How do sexually reproducing organisms produce gametes from diploid progenitors?

Through meiosis, which splits the number of chromosomes in half.

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13. How does the process increase gamete diversity?

Independent assortment of chromosomes and crossing over between homologous chromosomes increases gamete diversity.

14. What are the outcomes from independent assortment and crossing over?

The order the chromosomes can lie in results in greater genetic variation. In humans with 23 chromosomes, there are over 8 million possible combinations. Crossing over allows for exchange of genetic information, which creates unique chromosomes with varying information.

15. How does the distance between two genes or a gene and a centromere affect crossover frequencies?

The greater the distance between two genes or a gene and a centromere, the more likely there will be a crossover between them, separating the alleles. Crossover frequency increases with distance.

16. When is the DNA replicated during meiosis?

DNA is replicated in interphase, like mitosis.

17. Are homologous pairs of chromosomes exact copies?

NO, they are not.

18. What is crossing over?

The process in which homologs exchange genes.

19. What physical constraints control crossover frequencies?

The location of the gene on the chromosome.

20. What is meant by independent assortment?

The order chromosomes can lie in and then how they are randomly distributed to the gametes.

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21. How can you calculate the possible number of different kinds of gametes?

Multiply the possible genotypes for each gene

$2^{\text{number of gene pairs}}$ = number of different gametes

22. What happens if a homologous pair of chromosomes fails to separate, and how might this contribute to genetic disorders such as Down syndrome and cri du chat syndrome?

If a homologous pair fails to separate, there will be unequal distributions of chromosomes in the daughter cells, which could lead to genetic disorders. One gamete could have none, while one could have duplicate pair of chromosomes, leading to diseases like down syndrome.

23. How are mitosis and meiosis fundamentally different?

Mitosis produces two perfect replicates of the parent cell, while meiosis results in four daughter cells with half the chromosome number.

24. What evidence shows that mitosis is a continuous process, not a series of separate events?

A stage in mitosis may begin before another finishes at times, which shows that mitosis is continuous. This can also be seen when looking at the onion root tip, since some cells can be in phases that resemble other phases. For example, the cell could look similar to both prophase and interphase. Mitosis would not function properly if every event was separate from the other.

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