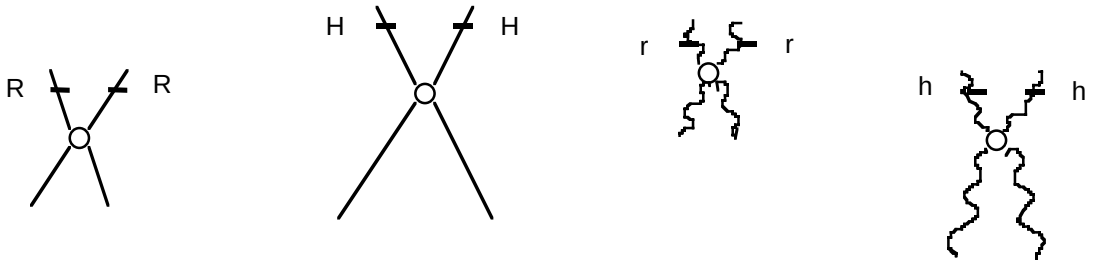
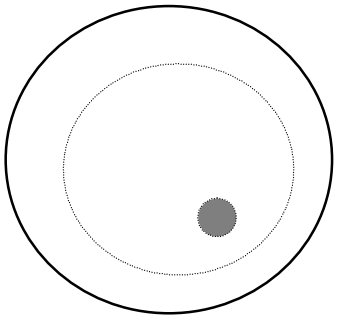
K. Sorensen Biol. 1310 Name: _____

Study Guide for Unit 2

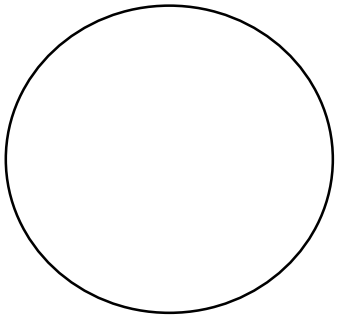
1. Name the asexual cell divisions.
2. What is the difference between yeast budding and binary fission?
3. Describe the parts of a chromosome
4. How are chromosomes packaged so tight?
5. What is a homolog?
6. What is a kinetochore and what is its function?
7. Diagram the cell cycle and tell what happens at each phase; G1, S, G2, and M.
8. Be able to diagram mitosis.
9. Which part of cell cycle is the longest for the cell?
10. What are contractile ring and a cell plate?
11. What is Go?
12. How is the cell cycle regulated? What molecules are involved?
13. What is cancer? What genes are involved?
14. What is apoptosis? What is necrosis?
15. What cell undergo meiosis? Mitosis?
16. Be able to diagram the stages of meiosis.
17. When does crossover occur?
18. When does the cell become haploid or reduction take place?
19. Describe the chiasmata or crossover.
20. Define the law of segregation and independent assortment.
21. Know how to calculate the number of gametes are possible given the diploid number of chromosomes.
22. What is nondisjuction? When does it occur? What are the results?
23. Be able to diagram spermatogenisis and oogenisis?
24. What are the sertoli cells, granulosa cells, primary spermatocytes, secondary spermatocytes, primary oocytes, and secondary oocytes.
25. What are the 3 types of meiosis and how are they different?
26. Be able to diagram the following steps of development in a sea urchin: fertilization, zygote, cleavage, blastula, gastrula.
27. What is the function of the germ layers? Endoderm, ectoderm, and mesoderm.
28. What is the gray crescent and what is its function?
29. What is holoblastic cleavage and what organisms does it occur?
30. What is meroblastic cleavage and what organisms does it occur?
31. What are the differences between asexual reproduction and sexual reproduction?
32. What are Mendel's laws of inheritance?
33. What is an allele?
34. What is homozygous, heterozygous, dominant, and recessive.
35. What is the genotypic ratio, phenotypic ratio for a F1 and F1 generation in a Monohybrid cross? A dihybrid cross?
36. Be able to diagram a monohybrid cross and a dihybrid cross using a punnett square or forking method (in the lab).
37. Although it may not be followed by the book, what is the proper naming of alleles?
38. How does linkage affect Mendelian ratios? Why?
39. Be able to analyze a pedigree. Tell me if it is autosomal dominant, autosomal recessive, x-linked dominant, x-linked recessive, y-linked dominant.
40. Describe how heterozygous advantage works in sickle cell anemia? What is the treatment for sickle cell anemia and how does it work?
41. Know the following genetic disorders: Cystic fibrosis, PKU, sickle cell, albinism, Huningtons, and Tay-Sachs disease.
42. Know examples of the variations of Mendelian genetics: incomplete dominance, multiple alleles, polygenic, epistasis, environmental effects, pleiotrophy, sex-linked, sex-influenced, and sex-limited.
43. How are linked genes mapped? Given the recombination frequencies, tell me how far apart the genes are.
44. How is sex determined in humans, birds, honeybees, and grasshoppers.
45. What is a bar body? Mosaic?
46. What is an RFLP?

1. Diagram the four stages of mitosis. Be sure to carry alleles at appropriate loci through the process in questions #'s 1 and 2. Use the following symbols for chromosomes, loci, and alleles.

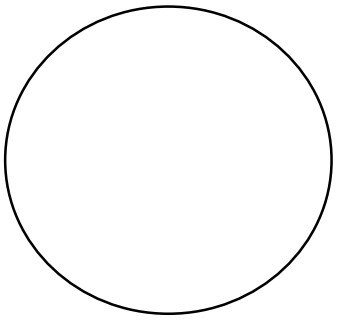




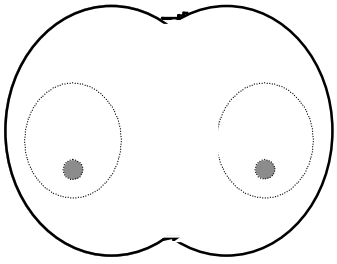
#1 Prophase



#2 anaphase

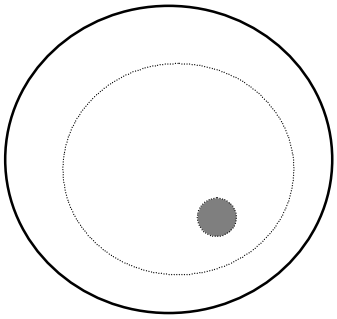


#3 metaphase

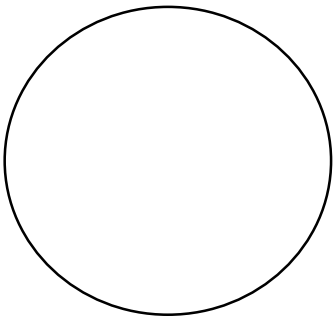


#4 telophase

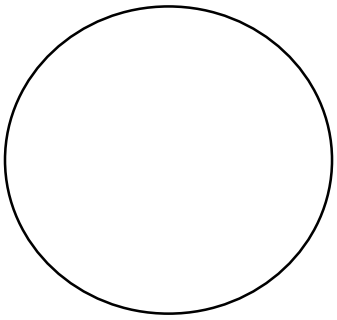
2. Diagram the eight stages of meiosis. Use the chromosomes and alleles described above in your drawings.



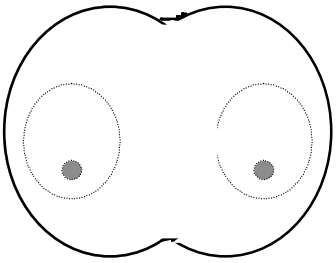
#1 Prophase I



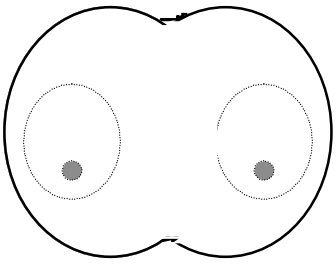
#2 Metaphase I



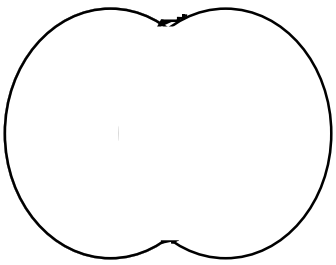
#3 Anaphase I



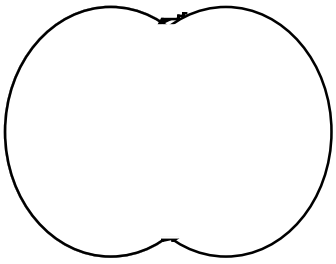
#4 Telophase I



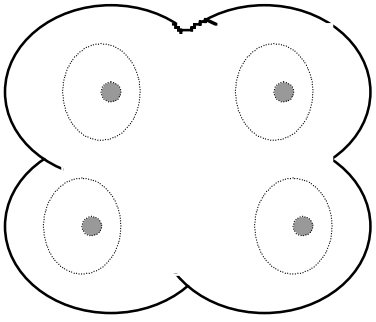
#5 Prophase II



#6 Metaphase II



#7 Anaphase



#8 Telophase

Choose the appropriate letters for the numbered blanks below.
Letters may be used more than once or not at all.

a) pairing of nonhomologous chromosomes
b) pairing of homologous chromosomes
c) pairs of homologous chromosomes
d) bivalent chromosomes (2 chromatids each)
e) crossing-over or DNA recombination
f) univalent chromosomes (1 chromatid each)
g) pairs of nonhomologous chromosomes
h) cells have 1N number of chromosomes

Prophase I of meiosis differs from mitotic prophase in that in Prophase I, 3. ____ and 4. ____ occur. Metaphase I differs from metaphase in that in Metaphase I, 5. ____ align on the equatorial plate. Anaphase I differs from anaphase in that in Anaphase I, pairs of homologous chromosomes are pulled apart and 6. ____ migrate to opposite poles. Anaphase II is similar to anaphase in that 7. ____ are pulled apart at the centromeres and 8. ____ migrate to opposite poles.

Choose the appropriate letters for the numbered blanks below.

a) Prophase I b) Prophase II c) Metaphase I d) Metaphase II e) Anaphase I f) Anaphase II

a) $2^4 = 16$ b) $2^2 = 4$ c) $2^5 = 32$ d) $2^3 = 8$ e) $2^1 = 2$ f) $2^6 = 64$

a) 7 b) 14 c) 28 d) 47 e) 94 f) 42

The function of meiosis is to produce haploid sex cells that upon fertilization unite to form a diploid zygote. Haploidy is effectively accomplished in what stage of meiosis? 9. ____ The primary function of sex is to produce genetic variation in the offspring. One component of this is expressed in Mendel's law of independent assortment where homologous chromosomes align themselves independently of other homologous pairs in this meiotic stage 10. ____ . If a diploid organism has ten chromosomes [hint: 5 pairs], how many different gametes can be produced just by independent assortment of whole chromosomes alone? 11. ____ (Assume one heterozygous locus for each homologous pair of chromosomes.) A second component of genetic recombination occurs in the pachytene stage of 12. ____ where the synaptonemal complex has brought homologous chromosomes together so that recombinant nodules are able to break adjacent DNA strands and repair them so that 50% of the time the broken strands reattach to different parent molecules. This is called crossing-over. In relation to Mendel's law of segregation **given that no crossing-over occurs** among homologous chromosomes, where do alleles at a given locus separate from each other into different daughter cells? 13. ____ . Meiosis occurs in special organs called gonads. In animals using humans as an example, the male meiotic process or spermatogenesis is carried out in the testes, and the female meiotic process or oogenesis takes place in the ovaries. In flowering plants the male meiotic organs are the anthers which top slender filaments and are collectively called stamens, and the female meiotic organs are the ovaries contained within the pistils of the flower. Diploid or normal pea plants (Pisum sativum) have 14 chromosomes. How many chromosomes would there be in one sperm nucleus of a pollen grain tube? 14. ____ In the young germinating sporophyte seedling how may chromosomes would there be in the nucleus of a palisade mesophyll cell in the leaf? 15. ____ In goldfish (Carassius auratus) the diploid number of chromosomes is 94. The spermatogonia in the testes of male goldfish have 94 chromosomes from which meiosis proceeds. How many chromosomes are there in the spermatids? 16. ____ In female goldfish primary oocytes at Metaphase I how many pairs of homologous chromosomes are aligned at the equatorial plate? 17. ____ In goldfish skin cells which undergo mitosis, how many chromosomes should one expect to find in each epithelial cell nucleus? 18. ____

19. What is meant by nondisjunction of chromosomes?

When does nondisjunction occur?

What has to happen in order for an individual to express Klinefelter Syndrome?

20. A true-breeding goat buck (Capra hircus) with black-coated and long-haired back crest is crossed with a true-breeding goat doe with white-coated and short-haired back crest. The progeny are all white-coated with long-haired back crest. (The results are the same for the reciprocal cross.) What is the genetic mechanism here? _____ _____

P	black-coated	long crest hair	X	white-coated	short crest hair
	— —	— —		— —	— —
F1	white-coated	long crest hair			
	— —	— —			

Give parental and F1 genotypes in the spaces provided above.

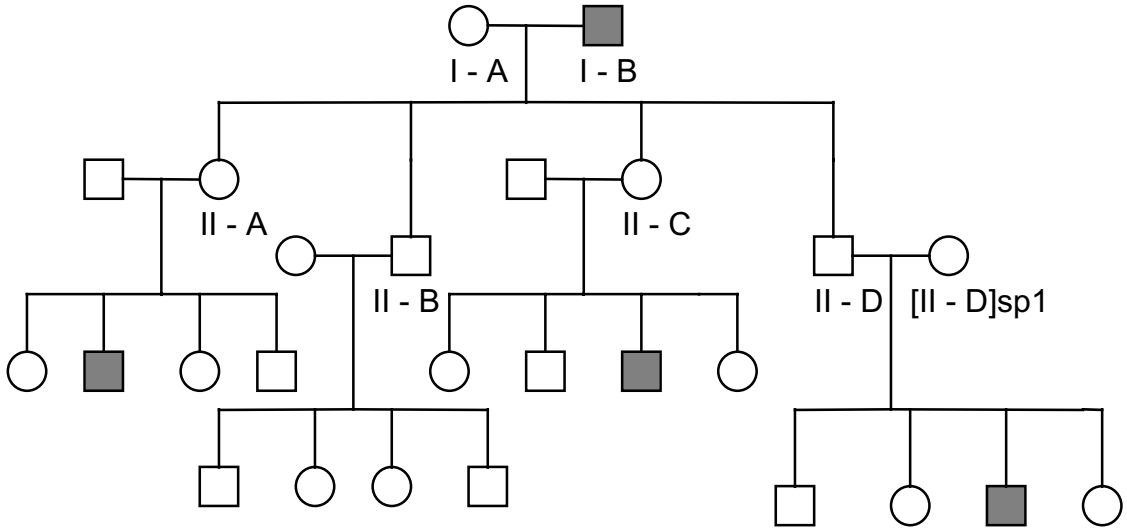
Give the F2 genotypes (3 pts) and their ratio (1 pt). Hint: you may want to use a Punnett Square, forking method or foiling method to solve this problem.

Give the F2 phenotypes (2 pts) and their ratio (1 pt).

ratio	phenotype

What would be the phenotype of the testcross parent? _____

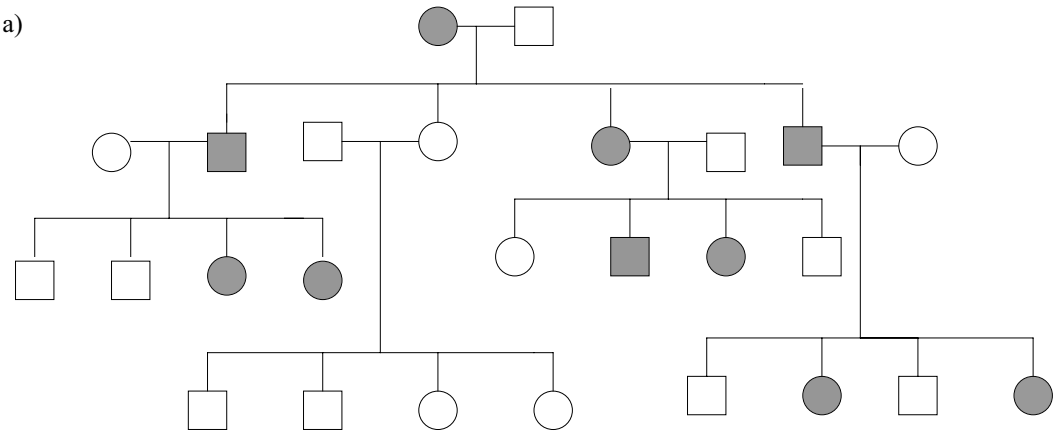
21. A grandfather has red-green colorblindness. None of his sons or daughters are afflicted with the disease. Half of his grandsons through his daughters have colorblindness, but none of his grandsons through his sons have this disorder. What type of genetic mechanism is this? _____ _____



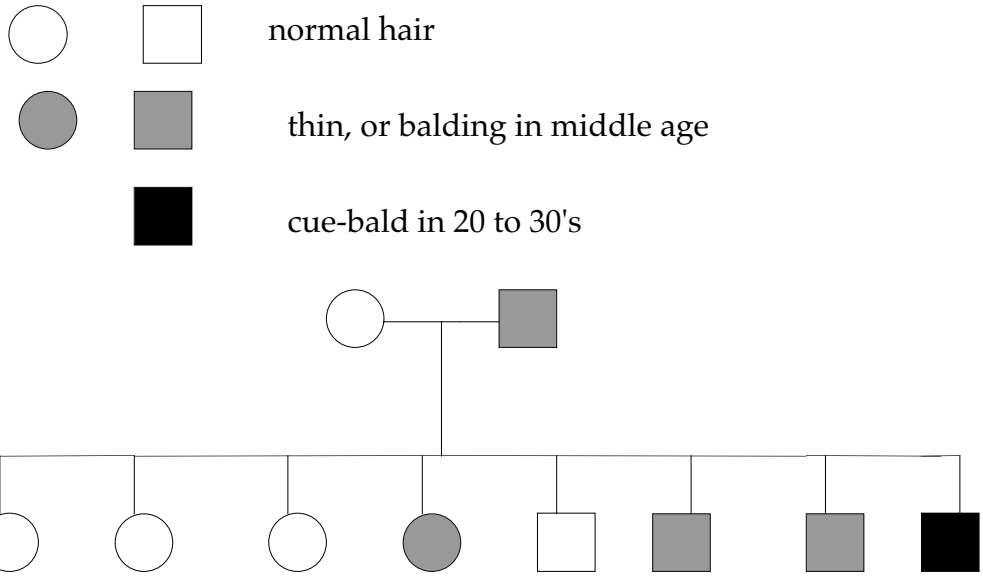
Give the genotypes (including chromosomes and alleles) for I-A, I-B, II-A, II-B, II-D and [II-D]sp1.

22. Determine the gene actions for each pedigree and justify each answer. Select from the following gene actions: autosomal recessive, autosomal dominant, X-linked recessive, X-linked dominant, Y-linked, or sex-influenced.

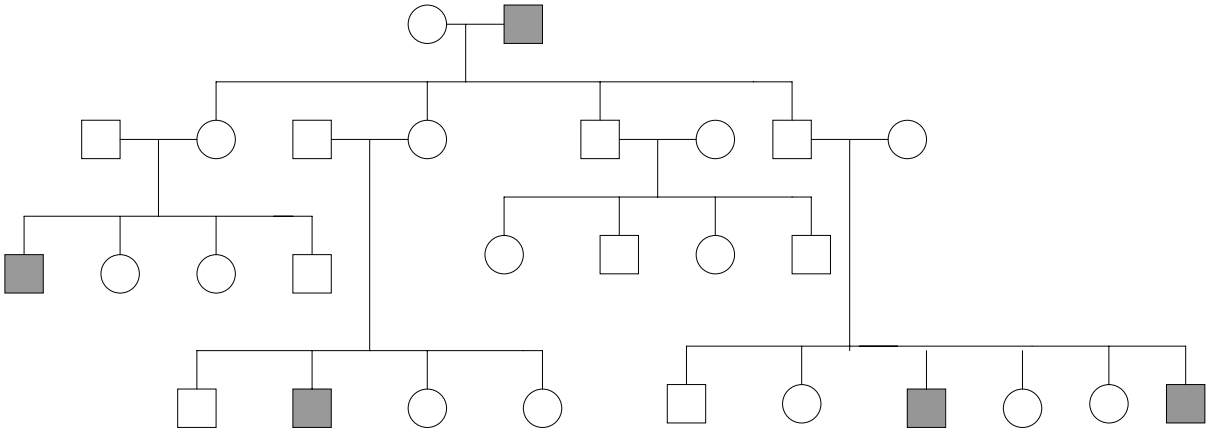
a)



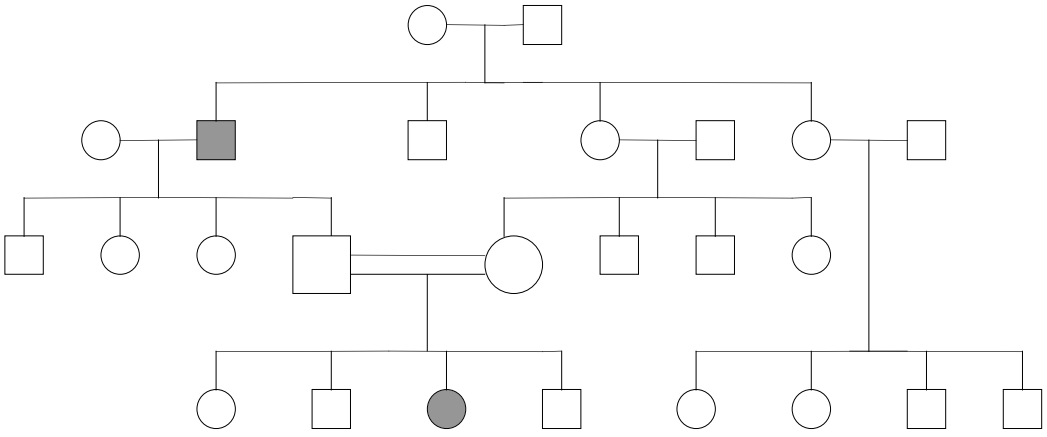
b)


normal hair
thin, or balding in middle age
cue-bald in 20 to 30's

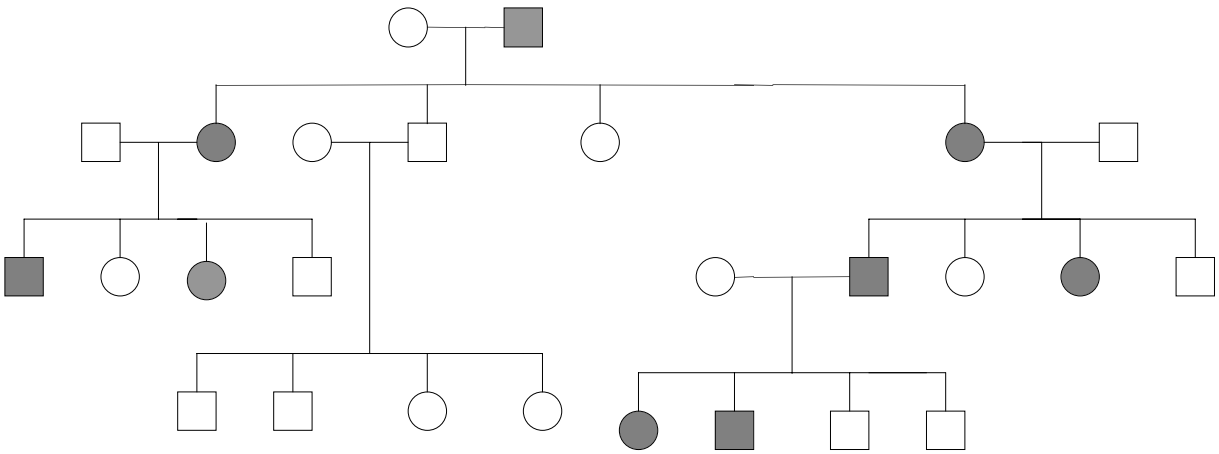
c)



d)



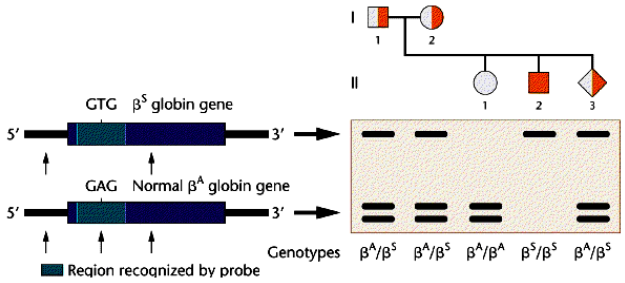
e)



23. When the DNA locus coding for the beta polypeptide chain of hemoglobin, a specific base triplet changes from CTC to CAC, the mRNA codon changes from GAG to GUG. Instead of glutamic acid, the amino acid valine now appears in the polypeptide. In individuals homozygous for this point mutation (HbS / HbS), the hemoglobin protein has two alpha polypeptide chains and two S chains (beta chains modified by one amino acid). When red blood cells enter the capillaries from the arterioles where the oxygen tension is low (less oxygen) and the H+ concentration is high (low pH), frequently the faulty S chains cause the hemoglobin protein molecule to become sticky so that thousands of hemoglobin molecules polymerize into long rod-shaped crystals in the red blood cell which cause the cell to distend into a sickle shape. These sickle-shaped red blood cells often get caught in the capillaries preventing passage of other red blood cells through the capillaries. This results in localized cell death, severe pain and cramps, anemia and ultimately death in the homozygous individual. In individuals heterozygous for the S chain (HbB / HbS), some red blood cells assume the sickle shape. In areas of the world afflicted by malaria sporozoans, humans heterozygous for sickle-cell anemia better survive attacks on the red blood cells by these protozoan parasites than do homozygotes for normal beta chain production because the sporozoans are killed inside the red blood cells that become sickled. Heterozygotes express both beta and S polypeptide chains in their hemoglobin. This is an example of codominance. According to the paper on the "Biophysics of Sickle Cell Hydroxyurea Therapy" by Eaton and Hofrichter hydroxyurea increases the production of gamma hemoglobin which with alpha hemoglobin forms fetal hemoglobin. What different forms of hemoglobin are <u>now</u> possible in individuals with sickle cell anemia?

How does this abate the effects of sickle cell anemia?

Such treated individuals have twice the risk of contracting leukemia or lymphoma. Suggest a possible reason.



The figure above represents a Southern blot diagnosis of sickle cell anemia.