Name:_____ Period:_____ Date:_____

Genetics TEST REVIEW

Vocab: be able to define or use these terms in answering questions on the test.

DNA, nucleus, chromosome, somatic cell, gamete cell, sexual reproduction, fertilization, dominant, recessive, gene, allele, genotype, phenotype, homozygous, heterozygous, hybrid, monohybrid cross, dihybrid cross, P generation, F1 generation, F2 generation, pedigree chart, polygenic inheritance, monozygotic twins (identical), dizygotic (fraternal twins), diploid, haploid, mitosis, meiosis, genetic variation, law of segregation, law of independent assortment, crossing over, homologous chromosomes, centromere, sister chromatids, DNA replication, parent and daughter cell, random fertilization, genome, genetic recombination.

Review Questions:

1. Explain the yeast investigation lab that we did in terms of the phenotypes of the P and F1 generation. Demonstrate your answer with a listing of genotypes and associated alleles in a Punnett square you create below.

The yeast we investigated had two phenotypes for color, red and cream. When pure red strain yeast colonies were crosses with pure cream strain yeast colonies, it was found that the cream strain was the dominant phenotype. Below is a Punnett square to back up this claim:

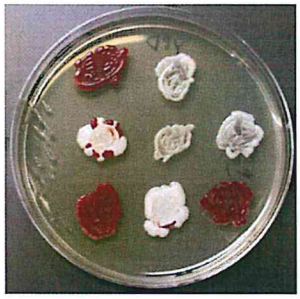
2. Who was Gregor Mendel and why is he considered the founder of modern genetics?

Gregor Mendel was an Austrian monk who discovered the basic principles of heredity through experiments with peas. Mendel's observations became the foundation of modern genetics and the study of heredity, and he is widely considered a pioneer in the field of genetics. He was the first to challenge the conventional thinking of genetics (that all traits are blended) and used mathematics and laws of probability to describe and explain specific patterns of inheritance.

3. Did Mendel's investigation with pea plant traits support the "blending" explanation for the pattern of inheritance (incomplete dominance)? Explain your answer.

No, they did not. For instance, when he crosses pea plants that were true breeding for a given trait such as tallness with one pure breeding for short (dwarf), the offspring F1 were not "medium, sized", rather they were all tall. When the F1 was crossed with itself, the trait for dwarfism emerged in the F2 generation.

   a. Compare his investigation with the yeast investigation that you did in lab.



In the yeast investigation the F2 generation There are two mating types of cells, like male and female types in animals. In yeast the mating types were a and α (alpha) for short. If cells of the two different mating types are growing near each other they will attempt to cross and create a diploid cell.In the simplest form we have two alleles at a single gene. If there is a simple dominant/recessive phenotype pattern it can illustrate why we expect a three to one ratio of offspring phenotypes from a cross between two heterozgytes (individuals that have two different types of alleles).

4. What is meant by diploid and haploid? What is our (humans) diploid and haploid chromosome number?

Diploid cells contain two complete sets (2n) of chromosomes. **Haploid** cells have half the number of chromosomes (n) as **diploid** - i.e. a **haploid** cell contains only one complete set of chromosomes.**Diploid** cells reproduce by mitosis making daughter cells that are exact replicas.

Human body (somatic) cells, which are diploid have 23 pairs of chromosomes, 46 total.

Human gamete (sex) cells, which are haploid have 23 chromosomes total.

5. Why is meiosis an important/necessary biological process?

Meiosis is important because it ensures that all organisms produced via sexual reproduction contain the **correct number of chromosomes.** Meiosis also **produces genetic variation** by way of the process of recombination.

6. Why is mitosis an important/necessary biological process?

Mitosis plays an important part in the development of embryos, and it is important for the growth and development of our bodies as well. Mitosis produces new cells, and replaces cells that are old, lost or damaged.

7. Compare and contrast the process of mitosis to the process of meiosis (in terms of # of parent cells, number of daughter cells produced and chromosome # in parent vs. daughter cells) - use a Venn diagram in the space below.

Mitosis	both	Meiosis
2n-> 2n	Chromosomes are duplicated (copied) before cell division occurs.	2n -> n
A biological process used for growth, repair and asexual reproduction.	Goes through prophase, metaphase, anaphase and telophase	Cells go through two divisions.
Cells go through only one division	Produce new cell(s).	Chromosomes are independently assorted into gametes.
Daughter cells are diploid (2N)	Way for cell to divide	Daughter cells are haploid (N).
Daughter cells are genetically identical (clones) to the parent cell.		Daughter cells are not genetically identical to the original ("parent") cell.
Daughter cells have a full set of chromosomes.		Daughter cells have half of the number of chromosomes.
Daughter cells have a full set of chromosomes.		Increases genetic diversity in offspring.
Produces 2 daughter cells		Involves crossing over (where genes are shuffled between chromosomes in metaphase).
Produces somatic (body cells)		Daughter cells have half of the number of chromosomes.
		Produce 4 daughter cells
		Produce gamete cells
		Produces sperm or egg cells.

8. If during meiosis the sister chromatids of one chromosome didn't separate properly, what problem might the resulting daughter cells have? What genetic disorder is associated with this type of chromosomal mistake?

The daughter cells would have an uneven number of chromosomes (nondisjunction), resulting in cells with too much/not enough genetic information to develop properly if at all, if fertilization takes place.

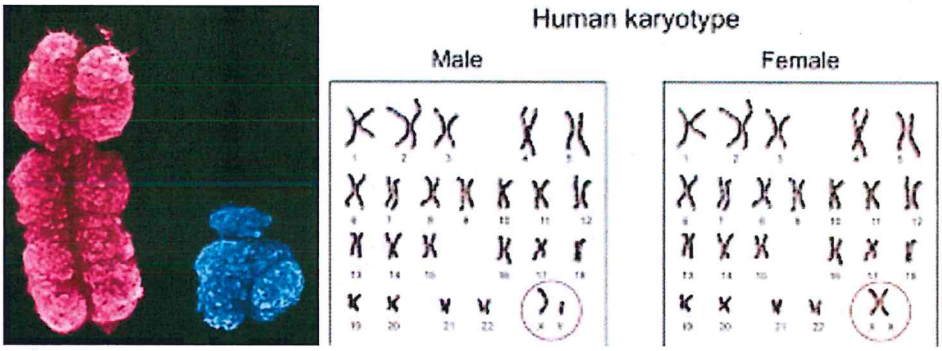
Genetic disorders resulting from this condition includes, Down syndrome (trisomy 21), Klinefelter syndrome, Fragile X syndrome, Turner syndrome, etc.

9. Explain how specific steps in meiosis creates genetic variation in gametes.

Genetic variation is increased by meiosis. During fertilization, 1 gamete from each parent combines randomly to form a zygote. Because of recombination and independent assortment **in meiosis**, each gamete contains a different set of DNA that is recombined in and through the cell's chromosomes. This produces a unique combination of genes in the resulting zygote.

10. How do males and females differ in their sex chromosomes? What are sex-linked traits and/or disorders?

Males have an X and Y chromosome, Females have two X chromosomes:



11. Why do members of the same family have different traits?

As mentioned in question 9, the genetic information of the parents is recombined and shuffled in meiosis via independent assortment of chromosomes and crossing over (where there is genetic exchange between homologous chromosomes), the random fertilization between gametes increases the shuffling of genes.

Did you know? There are 8,324,608 possible combinations of 23 chromosome pairs. As a result, two gametes virtually never have exactly the same combination of chromosomes. Each chromosome contains dozens to thousands of different genes. The total possible combination of alleles for those genes in humans is approximately 70,368,744,177,664. This is trillions of times more combinations than the number of people who have ever lived. This accounts for the fact that nearly everyone, except monozygotic twins, is genetically unique.

12. Circle the genotypes below that would be considered heterozygous:

(Aa) BB cc DD (Ee) ff (Gg) HH

13. In pea plants, having a smooth pod shape is dominant to a wrinkled pod. What are the possible genotypes for having a smooth pod? ___SS or Ss_____ What about wrinkled? _____ss___

14. What is the difference between genotype and phenotype?

he **genotype** is the set of genes in our DNA which is responsible for a particular trait. The **phenotype** is the physical expression, or characteristics, of that trait.

15. In flowers, long anthers (L) are dominant to short anthers (l). Cross a homozygous recessive and a heterozygous flower to give offspring. Show your work in a Punnett Square. Also, indicate the genotypic and phenotypic ratios for this cross. Demonstrate your answer with a listing of genotypes and associated alleles in a Punnett square you create below

L = long anthers
l = short anthers

	L	l
l	Ll	ll
l	Ll	ll

Ll : ll
1 : 1
long : short
1 : 1

16. In most mammals, brown/dark eyes are dominant over blue eyes. Is it possible for 2 brown eyed parents to produce blue-eyed offspring? Is it possible for 2 blue-eyed parents to produce brown-eyed offspring? Show evidence in the form of a properly labeled (key of alleles) Punnett square below.

	B	b
B	BB	Bb
b	Bb	bb

– yes

B = brown
b = blue

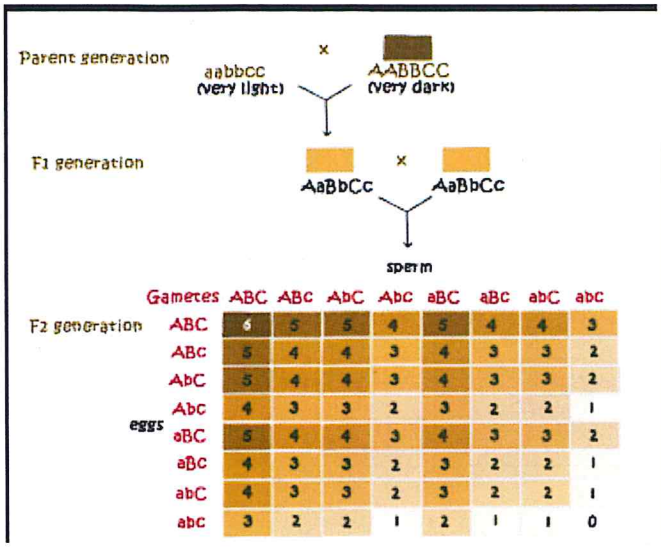
	b	b
b	bb	bb
b	bb	bb

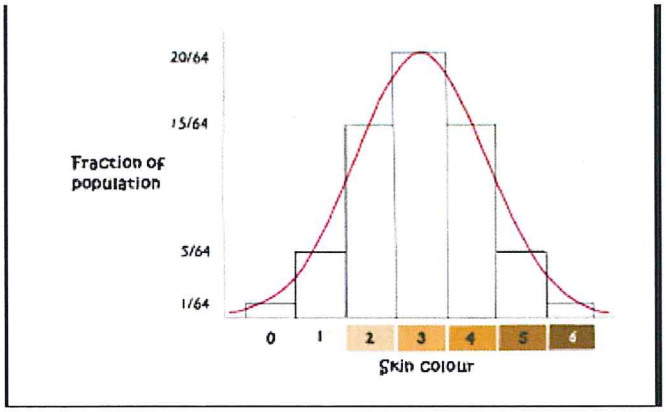
– NO

17. What type of inheritance is determined by multiple genes located at different loci on different chromosomes and there can be a range of traits? What does a graph of F1 generation of a trihybrid cross look like? What does this have to do with our phenomena?

Polygenic (multiple gene) inheritance.

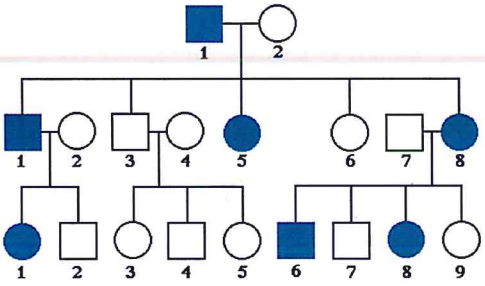
See next page

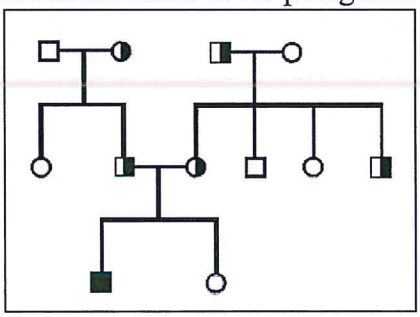


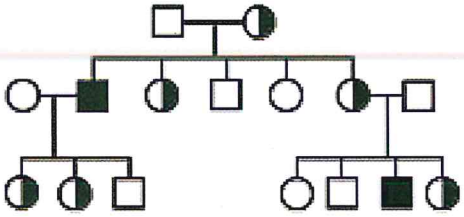


Polygenic traits show a continuous (bell-shaped distribution) rather than discontinuous (either/or) distribution (such as shown in Mendel's pea investigation).

18. Identify the pedigrees below as illustrating a trait that is either autosomal dominant, autosomal recessive, or X-linked recessive. Assign genotypes to each individual in the pedigrees.





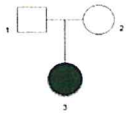


____autosomal dominant_____ ___autosomal recessive_____ ____X-linked recessive__

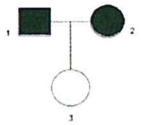
Trick to solving pedigrees

If the trait is much more common in males than females, the trait is X linked recessive.

The trait is recessive if it skips a generation

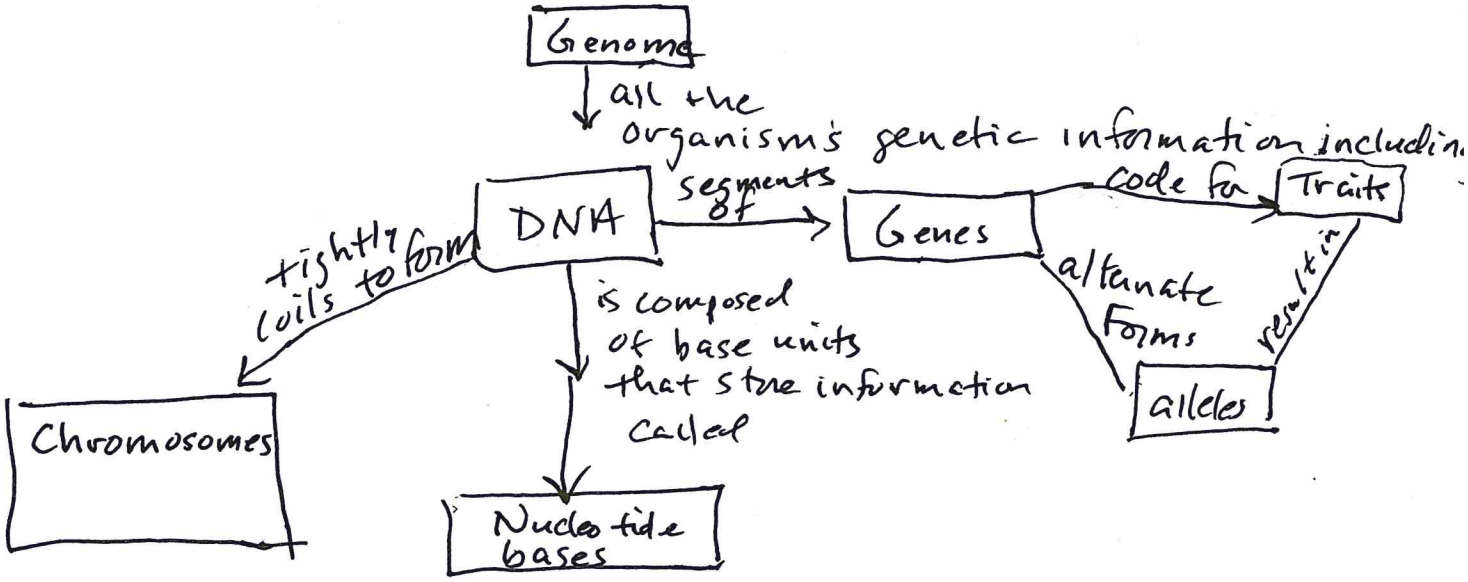


The trait is dominant if two parents with the trait have a child without the trait



What evidence supports your answer _____ (above)?

19. Make a concept map that shows the relationship between the following terms: DNA, chromosomes, genes, alleles, genome, nucleotide bases, and traits. Label your concept map and include linking terms to show how the terms are related.



20. The percent of each of the four nucleic acids (A,T,C & G) was determined for the 11 species below (the 1st is Greek to me:)). How does this data support Chargaff's claim for the structure of DNA in respects to base pairing rules?

For all organisms shown, there is approximately a 1:1 ratio for the A/T and C/G nucleotide combinations which indicates a "base pairing" rule that is the same for all organisms.

Organism	%A	%G	%C	%T	A/T	G/C	%GC	%AT
φX174	24.0	23.3	21.5	31.2	0.77	1.08	44.8	55.2
Maize	26.8	22.8	23.2	27.2	0.99	0.98	46.1	54.0
Octopus	33.2	17.6	17.6	31.6	1.05	1.00	35.2	64.8
Chicken	28.0	22.0	21.6	28.4	0.99	1.02	43.7	56.4
Rat	28.6	21.4	20.5	28.4	1.01	1.00	42.9	57.0
Human	29.3	20.7	20.0	30.0	0.98	1.04	40.7	59.3
Grasshopper	29.3	20.5	20.7	29.3	1.00	0.99	41.2	58.6
Sea Urchin	32.8	17.7	17.3	32.1	1.02	1.02	35.0	64.9
Wheat	27.3	22.7	22.8	27.1	1.01	1.00	45.5	54.4
Yeast	31.3	18.7	17.1	32.9	0.95	1.09	35.8	64.4
E. coli	24.7	26.0	25.7	23.6	1.05	1.01	51.7	48.3

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Q. Who said, "The amount of A = the amount of T, and the amount of G = the amount of C"?

answer choices

- Chargaff
- Avery
- Griffith
- Franklin

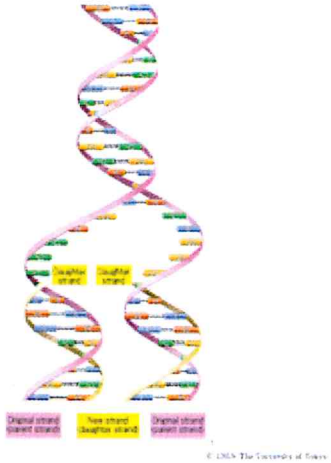
22

Q. If a DNA stand has 32 % guanine, what is the percentage of cytosine?

answer choices

- 100%
- 18%
- 32%
- 64%

23.Each half of an original DNA molecule serves as a template for a new strand, and the two new DNA molecules each have one old and one new strand.



This model of DNA replication is

A. Conservative
B. Semiconservative
C. Dispersive
D. None of the above

Explain in your own words how DNA is able to replicate itself.

DNA's unique structure enables the molecule to copy itself during cell division. When a cell prepares to divide, the DNA helix splits down the middle and becomes two single strands. These single strands serve as templates for building two new, double-stranded DNA molecules - each a replica of the original DNA molecule. In this process, an A base is added wherever there is a T, a C where there is a G, and so on until all of the bases once again have partners.

24. What are the main enzyme "players" in DNA replication? What do they do? What would happen if they were not present?

Enzyme	Function
Helicase	Unzipping the DNA helix
Primase	Synthesizing an RNA primer
DNA polymerase III	Adding bases to the new DNA chain; proofreading the chain for mistakes
DNA polymerase I	Removing primer, closing gaps, repairing mismatches
Ligase	Final binding of nicks in DNA during synthesis and repair

Of helicase were absent, the DNA molecule would not be "unzipped" providing template to copy from. Not adding a primer (job of primase) would mean that there would be no recognized starting point for DNA replication. Without DNA polymerase, the template or parent strand of DNA could not be built upon to make new DNA. Without DNA polymerase, "proofreading" of the new strands would not happen resulting in genetic mistakes (mutations).

25. What are undifferentiated cells? How do these cells contribute to the development of an organism?

Undifferentiated cells are the cells that have not yet become specialized, so these cells could still become any kind of cell that the body needs. in contrast, differentiated cells have become specialized cells for doing certain jobs ... muscle cells, skin cells, nerve cells, etc.

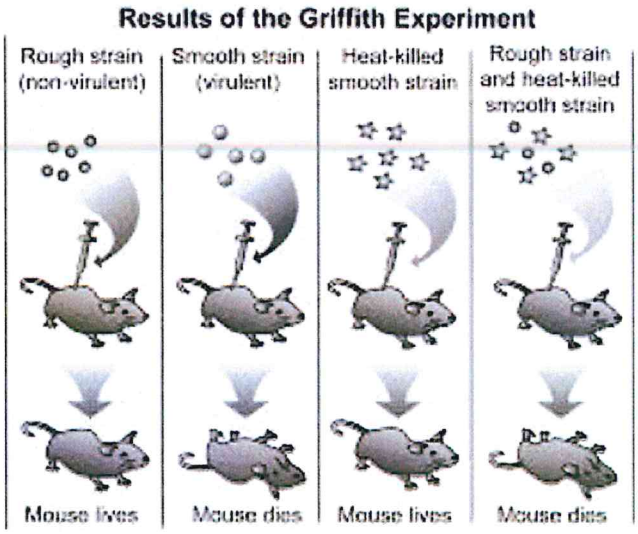
Stem cells are undifferentiated. Cells in early embryos are undifferentiated. The cells are multiplying, but they haven't started become specific types of cells. Over time though these cells are "cued" to become specialized cells that form tissues, organs and organ systems for an organism to become fully functional as it develops.

26. What claim, evidence and reasoning did Griffith's use from his mouse investigation (pneumonia) has lead to our current understanding (model) of information transfer?

Claim:

Griffith claimed that bacteria can get genetic information from other bacteria (even when the cells are dead) through a process called transformation.

Evidence:



Griffith reasoned

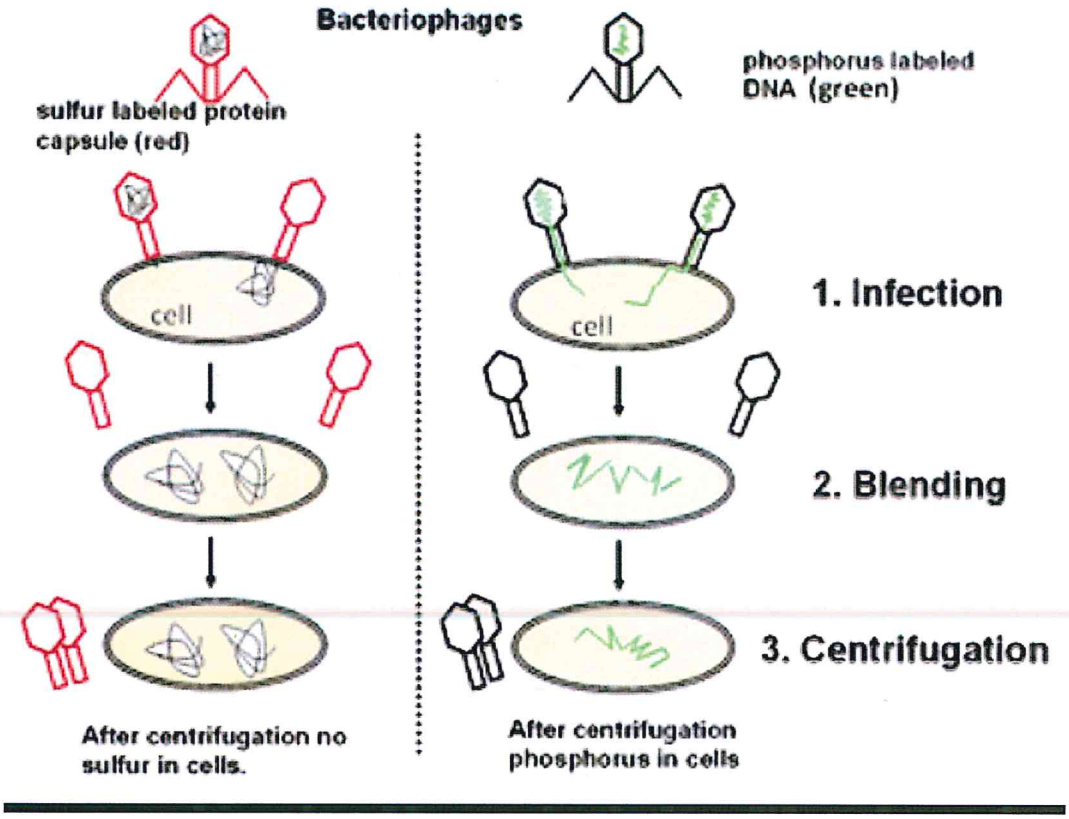
-some chemical factor could change harmless bacteria into disease-causing bacteria

-the factor was transferred from the heat-killed cells of the S strain into the live cells of the R strain.

27. What claim, evidence and reasoning did Hershey and Chase use from their famous "blender experiment". How did this investigation contribute to our current understanding (model) of information transfer?

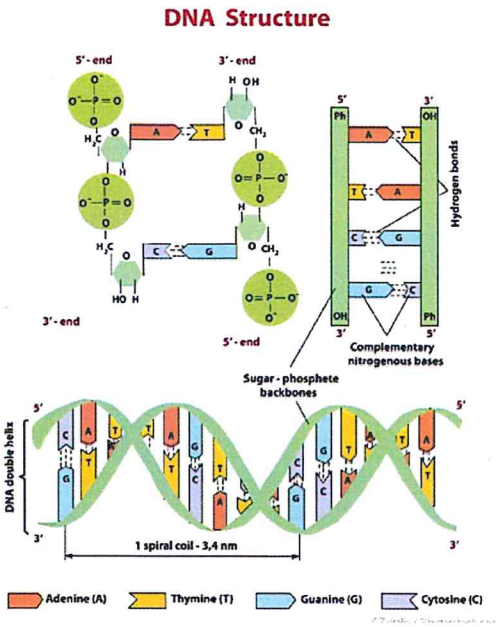
Claim: DNA, not protein, is the information carrying molecule of inheritance.

Evidence:



Reasoning: When the phage (virus) infected E.coli bacteria were analyzed, the phosphorus labeled molecule (DNA) were found inside the cell, not the sulfur labeled proteins, showing DNA, not proteins are the molecules of inheritance and was the genetic substance introduced by the phage (virus) into the bacteria cell.

28. In the space (below) describe the structure of DNA (include a labeled drawing).



To understand DNA's double helix from a chemical standpoint, picture the sides of the ladder as strands of alternating sugar and phosphate groups - strands that run in opposite directions. Each "rung" of the ladder is made up of two nitrogen bases, paired together by hydrogen bonds. Because of the highly specific nature of this type of chemical pairing, base A always pairs with base T, and likewise C with G. So, if you know the sequence of the bases on one strand of a DNA double helix, it is a simple matter to figure out the sequence of bases on the other strand.

29. Explain how the structure you described above related to the biological function of this amazing molecule.

DNA's unique structure enables the molecule to copy itself during cell division. When a cell prepares to divide, the DNA helix splits down the middle and becomes two single strands. These single strands serve as templates for building two new, double-stranded DNA molecules - each a replica of the original DNA molecule. In this process, an A base is added wherever there is a T, a C where there is a G, and so on until all of the bases once again have partners.

30. What is epigenetics? How does this field contribute to a deeper understanding of genetics? (might need to research this).

Epigenetics, as a simplified definition, is the study of biological mechanisms that will switch genes on and off in the cells of an organism.

The different combinations of genes that are turned on or off is what makes each one of us unique. Furthermore, there have been indications that some epigenetic changes can be inherited. The field of epigenetics shows us that classic Mendelian genetics is just part of the story of what makes each of us unique and that models that explain genetics need to add this dimension of complexity to understand inheritance and genetics.