DNA & Protein Synthesis Worksheet

Section A: Spitting DNA --- DNA extraction from your cells
DNA is found in the nucleus of your cells and is only about 50 trillionths of an inch long. The reason it can be seen in this activity is because you are releasing DNA from a number of cells. One strand of DNA is so thin you would never be able to see it without using a microscope.

What are you doing to your DNA?
The "secret cell lysis" solution is used to lyse or break open the cell membrane and nuclear membrane. The enzyme in meat tenderizer releases the DNA from the proteins it’s wrapped around. The alcohol causes the DNA to precipitate or settle out of the solution.

Materials: "secret cell lysis" solution (15 g salt, 1000 water & 100 ml clear shampoo), test tubes, alcohol, meat tenderizer, graduated cylinder, pipettes

Procedure:
1. Swish water in your mouth and spit in your tube. Make sure you scrape your teeth on your cheeks while swishing.
2. Add 3 ml of the "secret cell lysis" solution to your tube.
3. Add a pinch of meat tenderizer to your tube. Put the lid on your tube and gently flip the tube once to mix contents. Wait 5 minutes.
4. Slowly add 3 ml of isopropyl alcohol to your tube. Put the lid on your tube. Hold your tube still and watch. Look for clumps of white stringy stuff. This is your DNA!

Section B: DNA Timeline
On the 'Websites-Genetics' page, click on 'DNA Interactive'…..then click on 'Timeline'. Select the following scientist and briefly explain their contribution to Genetics.

<table>
<thead>
<tr>
<th>Pre 1920s</th>
<th>Friedrich Miescher</th>
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<tbody>
<tr>
<td>1920-1949</td>
<td>Oswald Avery</td>
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<tr>
<td>Early 50s</td>
<td>Erwin Chargaff</td>
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<td></td>
<td>Rosalind Franklin</td>
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<td></td>
<td>Alfred Hershey &amp;</td>
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<td></td>
<td>Martha Chase</td>
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<td>James Watson &amp;</td>
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<td></td>
<td>Francis Crick</td>
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<tr>
<td>Late 50s</td>
<td>Francis Crick</td>
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<tr>
<td></td>
<td>Matthew Meselson</td>
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<td></td>
<td>&amp; Franklin Stahl</td>
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Section C: DNA Structure
1. The structure of DNA is a double helix. The sides of the helix are made of alternating sugar and phosphate molecules. The sugar (S) is deoxyribose – color it blue. Color the phosphates (P) red. The bases are adenine (A), guanine (G), thymine (T) and cytosine (C). These bases always bond in a certain way. Adenine will only bond with thymine and guanine will only bond with cytosine. The bases can occur in any order along a strand of DNA and this order is the code that contains instructions. Color the ‘T’ orange, the ‘A’ green, the ‘G’ purple, the ‘C’ yellow. The two sides of the DNA helix are held together loosely by hydrogen bonds. The DNA can actually “unzip” when it needs to replicate - or make a copy of itself. DNA needs to copy itself when a cell divides, so that the new cells each contain a copy of the DNA. Without these instructions, the new cells wouldn’t have the correct information. Draw in the correct number of Hydrogen bonds.

2. Watson & Crick determined the shape of DNA is a ____________________.
3. What is the backbone of DNA composed of? _________________________
4. What part of the “backbone” connects to the nitrogen bases? ____________
5. What is the monomer of DNA? ________________________________
6. What are the 3 components of a nucleotide? ______________________
7. What is the sugar found in DNA? _________________________________
8. What are the 4 bases found in DNA? _______________________________
9. What is the name of the bond found between the bases? ______________
10. How many strands make up DNA? _______________________________
11. If a DNA strand contains 20% thymine, how many guanine molecules are present? __________
12. Given this segment of DNA, ATCGTA. What are the complimentary bases? ____________
13. Label the parts of DNA.
   a. X = _______________________
   b. W = _______________________
   c. Z = _______________________
14. The DNA strand is antiparallel. What does this mean? ________________________________________________________________
15. How many hydrogen bonds are found between the bases C&G? ________ the bases A&T? ________
16. Structurally, how are purines and pyrimidines different? 
   ________________________________________________________________
17. Which bases are purines? ____________ Which bases are pyrimidines? ____________
18. Explain how the DNA code works. 
   ____________________________________________________________________________
Section D: DNA Replication
1. Why is DNA replication necessary before each cell division? _____________________________
   _______________________________________________________________________________
2. What is DNA replication? _________________________________________________________
3. In Eukaryotes, where does DNA replication occur in the cell? _____________________________
4. In Prokaryotes, where does DNA replication occur in a cell? ______________________________
5. Why is DNA replication referred to as semi conservative? ________________________________
6. Which enzyme breaks apart the double helix? _________________________________________
7. Which enzyme adds complimentary bases to the template? ________________________________
8. The template strand of a piece of DNA being replicated reads: 5'ATAGGCCGT-3'. A partially
   synthesized Okazaki fragment is 5'CCTAT3'. What are the next four bases? _________________
9. In 1976, the enzyme DNA helicase was discovered. Which statement BEST describes how the
   discovery of DNA helicase furthered the understanding of DNA replication?
   a. It revealed the mechanism by which two DNA strands are “unzipped” from each other.
   b. It resulted in the development of laboratory methods of replicating RNA.
   c. It helped uncover the double-helix structure of DNA.

Section E: RNA vs. DNA
1. What is the monomer of RNA? ____________________________
2. After conducting several tests, a scientist determines that the nucleic acid sample he is studying
   has the following characteristics: Contains nucleotides; Contains 4 nitrogen bases; Made of single
   strand; Uracil is present. What is the BEST conclusion the scientist can make based on the
   observations? _______________________________________________________________________
3. Compare DNA and RNA.

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<tr>
<th></th>
<th>DNA</th>
<th>Both</th>
<th>RNA</th>
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Section F: Protein Synthesis Practice
1. Fill in the complimentary DNA strand using the base pair rule.
   DNA
   A   T   G   A   A   G   A   A   G   C   T   T
   DNA
   A   T   G   A   A   G   A   A   G   C   T   T

2. Use the complimentary strand of DNA to transcribe an mRNA strand.
   mRNA
   A   T   G   A   A   G   A   A   G   C   T   T
   Translate the mRNA to determine the amino acid chain.
   Amino Acid
   ________ ________ ________ ________
   tRNA
   ________ ________ ________ ________

Challenge: How many codons are needed to make 6 amino acids? ______
Section G: Transcription & Translation

1. What is transcription? __________________________________________________________

2. Where does transcription occur? ________________________________________________

3. Describe the function of RNA polymerase. _________________________________________

4. What are exons? ________________________________________________________________

5. What are introns? _______________________________________________________________

6. Write the complementary mRNA strands for the following DNA template strands:
   a. TATGAT  b. GGTCTA  c. TCATCG

7. In eukaryotic cells, mRNA is edited before leaving the nucleus. During the editing process, __.
   a. Introns and exons trade positions within the RNA strand
   b. Introns and exons are removed from the RNA
   c. Exons are removed from the mRNA while introns remain
   d. Introns are removed from the mRNA while exons remain

8. What is translation? ______________________________________________________________

9. Where does translation occur? ____________________________________________________

10. What are the 3 N-bases on mRNA called? _________________________________________

11. What are the 3 N-bases on tRNA called? ___________________________________________

12. What is the name of the bond formed between amino acids? _________________________

13. Identify each labeled structure. Use this wordbank: amino acid, polypeptide chain, anticodon, tRNA, mRNA
   I. ______________________________________ II. _____________________________ III. _____________________________ IV. _____________________________ V. _____________________________

14. What process is illustrated in the diagram? ________________________________________

15. True or False When an organism produces similar proteins, this indicates that organisms are more closely related.

16. Determine the amino acid sequence for the following DNA strand? CGACCTGAT

17. If the following tRNA anticodon is ACU, what would the original DNA triplet be? ______

18. Put the events of protein synthesis in order.
   _____ RNA moves from the nucleus to the cytoplasm.
   _____ DNA serves as a template for mRNA.
   _____ tRNA bonds to a specific codon.
   _____ Amino acids are bonded together.
   _____ mRNA attaches to a ribosome.

19. What is the Central Dogma?

20. Click on “TRANSCRIBE and TRANSLATE a gene”. Use the keyboard to type the bases that would form the mRNA. Now translate the mRNA by dragging the amino acid and tRNA.

On the ‘Websites-Genetics’ page, click on ‘Genetics Science Learning Center’…click on ‘molecules of inheritance’.