<table>
<thead>
<tr>
<th>DNA HW PACKET and Notebook</th>
<th>Points</th>
<th>Score</th>
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<tbody>
<tr>
<td>DNA Coloring WS</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>DNA and Replication WS</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Protein Synthesis Practice</td>
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<tr>
<td>How does DNA Determine the Traits of an Organism</td>
<td>3</td>
<td></td>
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<tr>
<td>How DNA Controls the Workings of the Cell</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Test Review</td>
<td>6</td>
<td></td>
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<tr>
<td><strong>INTERACTIVE SCIENCE NOTEBOOK</strong></td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Reflections</td>
<td>10</td>
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<tr>
<td>DNA Model WS and Diagram</td>
<td>5</td>
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<tr>
<td>Transcription and Translation coloring</td>
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<table>
<thead>
<tr>
<th>Standards Assessments</th>
<th>Points</th>
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<tbody>
<tr>
<td>DNA_RNA_Protein Test</td>
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<tr>
<td>DNA Model</td>
<td>50</td>
</tr>
<tr>
<td>Lab: DNA Extraction</td>
<td>25</td>
</tr>
<tr>
<td>Lab: Lego Protein Synthesis</td>
<td>25</td>
</tr>
</tbody>
</table>

**Total** 200
DNA STRUCTURE COLORING

1. **Color the parts** of the DNA in the diagram below

   - □ Adenine - Red
   - □ Guanine - Brown
   - □ Cytosine - Purple
   - □ Thymine - Yellow
   - □ Sugar - Black
   - □ Phosphate - Green

![Diagram of DNA helix]

2. Suppose the above DNA strand contains a base sequence **ATTCCGACG**.
   a. What is the sequence of the complementary strand?

   ________________________________

3. Why is the DNA helix above considered semi-conservative?

4. Why is the DNA helix above considered anti-parallel?

5. How do you know what part of the backbone of the DNA helix is sugars?

6. How do you know which bases is Adenine and which ones are Thymine?

7. What is a purine? Draw one...

8. What is a pyrimidine? Draw one…
DNA AND REPLICATION

1. What are the chemical components of DNA?

2. Explain the term DNA replication.

3. Define the following terms, used to describe the structure of DNA:
   a. phosphodiester bond
   b. complementary base pairing

4. What is the role of each enzyme involved in DNA replication?

5. The nucleotide sequence of a region of one DNA strand is GACTTACGACTAG what is complementary strand?

6. In a strand of DNA, the percentage of thymine is 30%. What is the percentage of cytosine in the same DNA strand?

7. About 21% of the bases in rat DNA are guanine. What are the percentages of the other bases? Explain your answer.

8. A nucleotide is made of three parts: a _________________________ group, a five carbon __________________________, and a nitrogen containing ____________________________.

9. In a single strand of DNA, the phosphate group binds to the ____________________________ of the next group.

10. Purines have ________ rings, and pyrimidines have ________ ring.

11. Chargaff's rule states that the DNA of any species contains equal amounts of ___________________ & ___________________ and also equal amounts of ___________________ & ___________________.

12. In DNA, thymine is complementary to _______________; cytosine is complementary to ___________________.

13. Number the steps of DNA replication in the correct order (1, 2, 3)
   ______ Daughter strands are formed using complementary base pairing.
   ______ DNA unwinds
   ______ The DNA of the daughter strands winds with together with its parent strand.

14. Why DNA replication is called “semi-conservative”? ____________________________

15. What enzyme unwinds are unzips the parent strand? __________________________

16. What enzyme synthesizes the new DNA strand? __________________________

17. What enzyme binds fragments of DNA on the lagging strand? __________________

18. On the diagram:
   a. Circle a nucleotide.
   b. Label the sugar and phosphate.
   c. Label the bases that are not already labelled
   d. The two sides of the DNA helix are held together by __________________________

19. Write out the complete name for DNA: ______________________________________

20. Name the scientist(s) responsible for each of the following discoveries.
   a. Proved that DNA was the genetic material, not Protein.
   b. Complimentary Bases occur in the same ratio to each other.
   c. The shape of DNA was a double helix
PROTEIN SYNTHESIS PRACTICE
TRANScribe AND TRANSLate THE FOLLOWING DNA STANDS
THEN LABEL EACH STRANDS AS DNA, mRNA, tRNA OR rRNA.

1) TACTTACCGAGATTCTTTGTTATC

2) TACATGTTATCCTGGTTGTTTATC

3) TACAAATCAGTACATTAGAGGACT

STRANGE CHANGES:
Transcribe and translate the following strands, then determine what type of mutation occurred and what new polypeptide chain (protein sequence) were created.

4) TACTGGGTATTCCTCGTCTCGGCGATT

START BY FINDING THE MUTATION (DIFFERENCE) BETWEEN THE STRANDS

5) TACTGGG TAGTTCCTCGTCTCGGCGATT

a) Would the previous DNA Sequences create the same protein?

b) Why or Why not?
How Does DNA Determine the Traits of an Organism

Introduction: In this simulation, you will examine the DNA sequence of a fictitious organism: the Snork. Snorks were discovered on the planet Dee Enae in a distant solar system. Snorks only have one chromosome with 6 genes on it. Your job is to analyze the genes of its DNA and determine what traits the organism has.

SNORK DNA AND TRAITS

<table>
<thead>
<tr>
<th>mRNA triplet</th>
<th>Amino Acid Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>UGG</td>
<td>20</td>
</tr>
<tr>
<td>UCG</td>
<td>16</td>
</tr>
<tr>
<td>GCU</td>
<td>2</td>
</tr>
<tr>
<td>UUG</td>
<td>4</td>
</tr>
<tr>
<td>GGG</td>
<td>3</td>
</tr>
<tr>
<td>CCC</td>
<td>5</td>
</tr>
<tr>
<td>UCC</td>
<td>7</td>
</tr>
<tr>
<td>UUU</td>
<td>8</td>
</tr>
<tr>
<td>AAA</td>
<td>9</td>
</tr>
<tr>
<td>CCA</td>
<td>12</td>
</tr>
<tr>
<td>AUA</td>
<td>13</td>
</tr>
<tr>
<td>GGG</td>
<td>1</td>
</tr>
<tr>
<td>UAG</td>
<td>6</td>
</tr>
<tr>
<td>GAU</td>
<td>10</td>
</tr>
<tr>
<td>CCU</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amino Acid Sequence</th>
<th>Trait</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-11-13</td>
<td>hairless</td>
</tr>
<tr>
<td>20-12-13</td>
<td>hairy</td>
</tr>
<tr>
<td>16-2 - 5</td>
<td>4 legged</td>
</tr>
<tr>
<td>16-4 - 5</td>
<td>2 legged</td>
</tr>
<tr>
<td>12-7-8</td>
<td>round head</td>
</tr>
<tr>
<td>5-7-8</td>
<td>block head</td>
</tr>
<tr>
<td>9-8 - 8</td>
<td>no tail</td>
</tr>
<tr>
<td>9-4 - 8</td>
<td>tail</td>
</tr>
<tr>
<td>11-3-2</td>
<td>slanted eyes</td>
</tr>
<tr>
<td>11-3-3</td>
<td>wide round eyes</td>
</tr>
<tr>
<td>6-6-10</td>
<td>Male (blue)</td>
</tr>
<tr>
<td>6-6-14</td>
<td>Female (pink)</td>
</tr>
</tbody>
</table>

Draw your Snork in the space below. Be creative!
How DNA Controls the Workings of the Cell

Below are two partial sequences of DNA bases (shown for only one strand of DNA). Sequence 1 is from a human and sequence 2 is from a cow. In both humans and cows, this sequence is part of a set of instructions for controlling a bodily function. In this case, the sequence contains the gene to make the protein insulin. Insulin is necessary for the uptake of sugar from the blood. Without insulin, a person cannot use digest sugars the same way others can, and they have a disease called diabetes.

BEFORE YOU BEGIN:

1. What is messenger RNA (mRNA)?

2. What is transfer RNA (tRNA)?

3. What is ribosomal RNA (rRNA)?

INSTRUCTIONS:

1. Using the DNA sequence make a complimentary mRNA strand from both the human and the cow. Write the mRNA directly below the DNA strand (remember to substitute U's for T's in RNA)

2. Create the tRNA strand from the mRNA strand

3. Use the codon table in your book to determine what amino acids are assembled to make the insulin protein in both the cow and the human.

4. Write your amino acid chain directly below the tRNA sequence.

<table>
<thead>
<tr>
<th>Sequence 1 - Human</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNA: T A C C A T A G C A C G T T A C A A C G T G A A G G T T A A</td>
</tr>
<tr>
<td>mRNA:</td>
</tr>
<tr>
<td>tRNA:</td>
</tr>
<tr>
<td>rRNA: (Amino Acids):</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sequence 2 - Cow</th>
</tr>
</thead>
<tbody>
<tr>
<td>mRNA:</td>
</tr>
<tr>
<td>tRNA:</td>
</tr>
<tr>
<td>rRNA: (Amino Acids):</td>
</tr>
</tbody>
</table>

Analysis

1. Comparing the human gene to the cow gene, how many of the codons are exactly the same? ____

2. How many of the amino acids in the sequence are exactly the same? ______
3. Could two humans (or two cows) have some differences in their DNA sequences for insulin, yet still make the exact same insulin proteins? Explain.

4. Find ALL of the codons that can code for the amino acid leucine (leu) and list them.

5. Diabetes is a disease characterized by the inability to break down sugars. Often a person with diabetes has a defective DNA sequence that codes for the making of the insulin protein.

Suppose a person has a mutation in their DNA and the first triplet for the insulin gene reads T A T; The normal gene reads T A G.
   a. What amino acid does the mutant DNA and the normal DNA code for and will the person with this mutation be diabetic? __________________________

6. Another mutation changes the insulin gene to read T C T (instead of the normal T A G). Will this person be diabetic? Explain.

7. DNA sequences are often used to determine relationships between organisms. DNA sequences that code for a particularly gene can vary, though organisms that are closely related will have very similar sequences.

This table shows the amino acid sequences of 4 organisms.
   a. Based on the sequences below, which two organisms are most closely related?

<table>
<thead>
<tr>
<th></th>
<th>Human: C C A T A G C A C C T A</th>
<th>Chimpanzee: C C A T A A C A C C T A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig:</td>
<td>C C A T G T A A A C G A</td>
<td>Cricket: C C T A A A G G A C G</td>
</tr>
</tbody>
</table>

8. An unknown organism is found in the forest and the gene is sequenced as follows:
   Unknown: C C A T G G A A T C G A
   a. What kind of an animal do you think this is? _______________________________
1) Using the PPT notes and the pairing rules below, make a DNA Model with the materials provided:
   - Black 3 Prong: Sugar (12)
   - Red 2 Prong: Phosphate (10)
   - White 2 Prong: Hydrogen Bond (6)
   - Yellow: Phosphodiester Bond (20)
   - Green: Cytosine (3)
   - Grey: Guanine (3)
   - Red: Thymine (3)
   - Blue: Adenine (3)

2) Draw your DNA Model (FLAT)

3) Label the following parts:
   a) Nitrogen Bases
   b) Base Pair
   c) A Nucleotide
   d) Hydrogen Bonds
   e) Phosphodiester Bonds

4) NOW TWIST! You’ve made a DNA Molecule

QUESTIONS:
1) What is the order of your base pairs?

2) Which nitrogen base binds with Guanine?

3) What part of the DNA do the base pairs bonded to?

4) What is the role of the Hydrogen bonds?

5) How many hydrogen bonds are there between
   a) A and T
   b) C and G

6) What binds the Sugars -Phosphates to each other?

7) What kind of sugar is in DNA?
Protein Synthesis Coloring - Transcription & Translation

Transcription

RNA, Ribonucleic Acid is very similar to DNA. RNA normally exists as a single strand (and not the double stranded double helix of DNA). It contains the same bases, adenine, guanine and cytosine. However, there is no thymine found in RNA, instead there is a similar compound called uracil. Transcription is the process by which RNA is made from DNA. It occurs in the nucleus. Label the box with the x in it near the nucleus with the word TRANSCRIPTION and proceed to color the bases according to the key below

- Thymine = orange
- Adenine = dark green
- Guanine = purple
- Cytosine = yellow
- Uracil = brown

(Color the strand of DNA dark blue (D) and the strand of RNA light blue (R). Color the nuclear membrane (E) gray.)

Translation

Translation occurs in the cytoplasm, specifically on the ribosomes. The mRNA made in the nucleus travels out to the ribosome to carry the "message" of the DNA. Here at the ribosome, that massage will be translated into an amino acid sequence. Color the ribosome light green (Y) and note how the RNA strand threads through the ribosome like a tape measure and the amino acids are assembled. The RNA strand in the translation area should also be colored light blue, as it was colored in the nucleus.

Label the box with the X in the translation area with the word TRANSLATION.

Important to the process of translation is another type of RNA called Transfer RNA (F) which function to carry the amino acids to the site of protein synthesis on the ribosome. Color the tRNA red.

A tRNA has two important areas. The anticodon, which matches the codon on the RNA strand. Remember that codons are sets of three bases that code for a single amino acid. Make sure you color the bases of the anticodon the same color as the bases on your DNA and RNA strand - they are the same molecules!

At the top of the tRNA is the amino acids. There are twenty amino acids that can combine together to form proteins of all kinds, these are the proteins that are used in life processes. When you digest your food for instance, you are using enzymes that were originally proteins that were assembled from amino acids. Each tRNA has a different amino acid which link together like box cars on a train. Color all the amino acids (M) pink.
Answer these questions on the LEFT SIDE Reflection
1. How many different kinds of bases can be found on DNA _____
2. What base is found on RNA but not on DNA? ____________
3. How many bases are in a codon? ______; in an anticodon? ____________
4. How many amino acids are attached to a single transfer RNA? _______
5. Transcription occurs in the ___________; translation occurs in the ____________.
6. The process of making RNA from DNA is called _______________ and it occurs in the _________________.
7. The process of assembling a protein from RNA is called _______________ and it occurs in the
DNA STUDY GUIDE

1. What does DNA stand for? ________________________
2. What does RNA stand for? ________________________
3. What (in general) does a DNA Molecule look like? ______________________
4. What kind of sugar is in DNA? ______________________
5. What are the two types of bonds found in a DNA Molecule? 
   ___________________ and ______________
6. Which bonds the sugar to the phosphate? ________________
7. How many bonds are there between A/T? _________ G/C? _________
8. What are the chemicals that make up the backbone? ______________ & ______________.
9. What is the enzyme responsible for unwinding the DNA so it can replicate? ______________
10. What is the enzyme responsible for making the new DNA? ___________
11. Which of the bases are purines? _____________ pyrimadines? __________
12. What is the difference between a purine and pyrimadines?
    ______________________________________________________________________________________
    ______________________________________________________________________________________
    ______________________________________________________________________________________
13. Describe the parts of a nucleotide?
14. What are the different types of Nitrogen bases that can be found in DNA
    ______________________________________________________________________________________
    ______________________________________________________________________________________
    ______________________________________________________________________________________
Which bases bind to each other?

15. Which base is found only in RNA? _______________________
16. Draw a detailed picture of the DNA molecule. Make sure to include.
   a. Nitrogen Bases
   b. A Nucleotide
   c. Bas Pair
   d. Hydrogen Bonds ( #)
   e. Ester Bonds
   f. Circle a nucleotide
   g. Square in a base pair
17. What are the different types of RNA?
   a. ______________________
   b. ______________________
   c. ______________________

18. Describe the jobs of each.
   a. ____________________________________________________________
   ____________________________________________________________
   b. ____________________________________________________________
   ____________________________________________________________
   c. ____________________________________________________________
   ____________________________________________________________

19. Use a T-Chart to explain the differences between DNA and RNA (Detail)

<table>
<thead>
<tr>
<th>DNA</th>
<th>mRNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>T A C T A T T C C T G T C T C G G C G T A T T</td>
<td></td>
</tr>
</tbody>
</table>

20. What organelle processes the RNA during Translation? _________________

21. The process of Transcription makes _______ from _____________

22. The process of Translation makes ___________ from ____________

23. Where does Transcription occur? _______________

24. Where does Translation occur? _______________

25. What is a codon?
   __________________________________________________________________
   __________________________________________________________________

26. USE THE GENETIC CODE TO TELL ME WHAT AMINO ACID SEQUENCE EACH STRAND CODES FOR!

   DNA    T A C T A T T C C T G T C T C G G C G T A T T
   mRNA_______________________________________________________________________
   tRNA________________________________________________________________________
   rRNA/aa_______________________________________________________________________

26. Transcription and Translation for the following Strand of DNA.
27. Transcription and Translation for the following Strand of DNA.

DNA   T A C T G G G T A T G T C G G C G T A T T

mRNA ___________________________
tRNA ___________________________
rRNA/aa__________________________

28. Define Transcription and Translation and describe how they result in genes, and how those genes code for a protein.

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

29. Is the whole chromosome made of DNA? ______________

30. What is a gene?

_______________________________________________________________________________
_______________________________________________________________________________

31. Describe the difference between an Exon and Intron.

_______________________________________________________________________________
_______________________________________________________________________________

32. Given the fact that all cells contain the entire set of genes for an organism, why are only certain genes expressed in certain parts of the body?

_______________________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________

33. How many different amino acids are there? ____________

34. How can that many amino acids form 100,000’s of different proteins?

_______________________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________

35. Is the DNA exactly the same in each cell in the body? Explain!

_______________________________________________________________________________
_______________________________________________________________________________

36. If cells do all have the same DNA why don’t they all express the same proteins?

_______________________________________________________________________________
_______________________________________________________________________________
Examples: __________________________________________

37. How often do we see variation in the genetic code of humans? __________________________

38. What are those variations called? ____________________________________________