PART 1: STRUCTURE OF DNA & RNA
Your DNA Model Kit contains the following components:

1. Please use colored pencils or highlighters to color each component. Be sure to use the colors listed above so that the colors in your lab match the colors of your model pieces.

2. The diagram below shows the chemical structure of the two nucleic acids, RNA and DNA:
a. Please color each base using the SAME colors used in your DNA Model Kits.
b. Please color each ribose sugar & deoxyribose sugar in the SAME colors used above.
c. Please put a box around 1 nucleotide of RNA and another box around 1 nucleotide of DNA.
d. List 3 major STRUCTURAL differences between RNA and DNA:

<table>
<thead>
<tr>
<th>RNA</th>
<th>DNA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

3. The letters “DNA” stand for “deoxyribonucleic acid.”
   a. Where does the “D” in “DNA” come from? __________________________________________
   b. What do you think “RNA” stands for? __________________________________________

4. Using your kits, please build 1 nucleotide of DNA and 1 nucleotide of RNA. Draw and color each below. Label the 3 parts of each nucleotide.

<table>
<thead>
<tr>
<th>RNA Nucleotide</th>
<th>DNA Nucleotide</th>
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</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

5. Build 12 RNA nucleotides, using a variety of bases.

6. Build a double helix of DNA that is 10 base pairs long, using a variety of bases.
7. Please examine Model 1, above. Color ALL nucleotides using the SAME colors as your DNA Model Kit.

8. Which nucleic acids are involved in this process? ______________________________________________________

9. Where is the DNA located in a cell? _________________________________________________________________

10. Where is this process occurring? ___________________________________________________________________

11. Which molecule is being synthesized (built)? _______________________________________________________

12. What is the name of this process? ___________________________________________________________________

13. What building blocks are used to construct this molecule and where are they found? ____________________________
14. What is the base pair rule for complementary DNA & RNA strands:

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

15. How does this compare to the base pair rule for complementary DNA strands?

16. Consider what you know about the cell life cycle, as well as the information shown in the diagram above. During which phase(s) of the life cycle can this process occur? Why can it NOT occur during the other phase(s)?

17. Before the printing press was invented, books had to be transcribed in order to share the information in them. Consider the definition of “transcription” and explain why the process in shown in the diagram is described using that word.

18. Please clear your table of everything except your model. Your whole table will represent a cell.
   a. Designate an area of the table to be the nucleus of the cell. Mark it off using yarn
   b. Place the DNA and RNA that you built in the appropriate location in your cell.

19. Begin unzipping your DNA double helix. What type of bond is broken as the DNA unzips?

20. As the DNA unzips, immediately begin pairing the free RNA nucleotides with one strand. Build a complimentary strand of RNA that is 9 bases long.
   a. What type of bond holds the RNA nucleotides to the DNA bases?
   b. Record the order of the bases in your DNA and in your complimentary RNA:
   DNA:_________________________________________________________________________________________________________
   RNA:_________________________________________________________________________________________________________
21. After the strand of RNA is complete, unzip it from the DNA at the hydrogen bonds. Where will the RNA go next? ______________________________________ (Show this in your model.)

22. What happens to your original DNA strand after the RNA unzips? (Show this in your model.)

23. Why is it important for transcription that hydrogen bonds are weak chemical bonds?

PART 3: TRANSLATION

Model 2 – Translation

[Diagram showing translation process with amino acids and RNA binding to ribosomes]
24. Please examine Model 2, above. Color the ribosome purple. Color all bases (letters) using the colors from your kits. Trace all tRNA in green.

25. The different shapes labeled “Met,” “Ala,” “Ser,” etc represent ________________________________.

Once joined together, they are called a ________________________________. (Please label this in Model 2.)

26. What are the three stages of translation, shown in Model 2?

<table>
<thead>
<tr>
<th>Three stages of translation:</th>
<th>Define each of these terms as they are used in everyday language:</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

27. When the mRNA leaves the nucleus, to which organelle does it attach? _______________________

28. The mRNA always begins with the sequence “AUG.” According to your amino acid chart, what does “AUG” code for? __________________________________________

29. AUG is an example of 1 codon. Please label 1 codon in the diagram above. In your own words, define “codon.”

30. Each tRNA molecule carries a specific amino acid that matches its anticodon.

   a. Find the tRNA in Model 2 that is carrying histidine (His). What sequence of bases make up the anticodon on this tRNA molecule? __________________________________________

   b. What codon on the mRNA would match this anti-codon? ________________________________

   c. Use your amino acid code to verify that this codon does code for histidine.

   d. What anticodon would be found on a tRNA molecule carrying glycine (Gly)? (Note: There are 4 possible anticodons. Please list all.) __________________________________________
31. What happens to the tRNA after it delivers its amino acid?

32. Count the number of amino acids that make up the final protein in Model 2. ____________ How many tRNA molecules were needed to build this protein? ____________ How many mRNA bases were needed to complement these tRNA molecules? _____________. Use this example to complete the table below:

<table>
<thead>
<tr>
<th>Number of Amino Acids in Protein:</th>
<th>Number of tRNA molecules needed:</th>
<th>Number of complementary mRNA bases:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>300</td>
</tr>
</tbody>
</table>

33. The “t” in tRNA stands for “transfer.” In a complete sentence, explain why this is an appropriate name.

34. The “m” in mRNA stands for “messenger.” In a complete sentence, explain why this is an appropriate name.

35. In common language, we use the word “translation” to describe changing information from one language to another. Explain why this is a appropriate term to describe the process shown in Model 2.
36. Examine the molecule of mRNA that you built in Part 2, above.
   a. How many bases long is it? ______________________________
   b. How many molecules of tRNA will you need to translate it? ______________________________
   c. Use your amino acid chart to translate your mRNA:
      mRNA: _____________________________________________________________________________
      Protein: ___________________________________________________________________________

37. The bases that make up your tRNA anticodons must complement your mRNA. List your tRNA anticodons:
      mRNA: _____________________________________________________________________________
      tRNA: ______________________________________________________________________________

38. In your kit, the purple bars represent tRNA and the black bars represent amino acids. Build 3 molecules of tRNA, each carrying 1 amino acid. (Be sure that the bases in your tRNA match your answer to #37.)

39. Place these, as well as your large purple ribosome, in the area of the table the represents the cytoplasm of the cell.

   STAMP

40. After transcription, your mRNA strand leaves the nucleus and moves to the cytoplasm of the cell.
   a. Use hydrogen bonds to bind each codon and anticodon together.
   b. Use 2 dark gray tubes to connect adjacent amino acids. (These gray tubes represent the bonds, called “peptide bonds,” that form between amino acids.)
   c. What organelle helps to facilitate this process? __________________________________________

41. Disconnect the amino acid chain from the tRNAs. It is now a finished protein, free to carry out its function in the cell.

42. The tRNA then disconnects from the RNA strand, and is free to be reused again in the cytoplasm of the cell. The cell typically breaks the RNA strand back into its nucleotides, which can be reused in the nucleus to build more RNA strands in the future. (Please show these final steps in your model.)
PART 4: SUMMARIZE

43. Please transcribe and translate this DNA.

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

RNA codons: ____________________________________________________________

tRNA anti-codons: _______________________________________________________

Protein: ________________________________________________________________

44. Predict: What would happen to your amino acid chain if there is a mutation in the original DNA so that, instead of "A C A" that codon in the DNA reads "A C T"?

__________________________________________________________________________
__________________________________________________________________________

45. Please fill in the blanks in the diagram below:

![Diagram of DNA replication and protein synthesis]