UNIT 24: Nucleic Acids **Name: _____**

Essential Idea(s): The structure of DNA allows efficient storage of genetic information.

IB Assessment Statements

2.6.U1 The nucleic acids DNA and RNA are polymers of nucleotides.

- State the two types of nucleic acid.
- Outline the parts of a nucleotide.
- Identify and label carbons by number (for example, C1, C2, C3) on a nucleotide drawing.
- Explain how nucleotides can connect to form a nucleic acid polymer.
- State the names of the nitrogenous bases found in DNA and RNA.
- Identify nitrogenous bases as either a pyrimidine or purine.
- State the complementary base pairing rules.

2.6.U2 DNA differs from RNA in the number of strands present, the base composition and the type of pentose.

- Compare the structure of DNA and RNA.

2.6.U3 DNA is double helix made of two antiparallel strands of nucleotides linked by hydrogen bonding between complementary base pairs.

- Define antiparallel in relation to DNA structure.
- Outline the formation of a DNA double helix by hydrogen bonding between nitrogenous bases.
- Identify the four bases of DNA based on the numbers of rings (purines or pyrimidines) and the number of hydrogen bonds it can form.
- State the number of nitrogenous bases per complete turn of the DNA double helix.

2.6.S1 Drawing simple diagrams of the structure of single nucleotides of DNA and RNA, using circles, pentagons, and rectangles to represent phosphates, pentoses, and bases.

- Draw the basic structure of a single nucleotide (using circle, pentagon and rectangle).
- Draw a simple diagram of the structure of RNA.
- Draw a simple diagram of the structure of DNA.
- Identify and label the 5’ and 3’ ends on a DNA or RNA diagram

2.6.A1 Crick and Watson’s elucidation of the structure of DNA using model making.

- Outline the role of Chargaff, Watson, Crick, Franklin and Wilkins in the discovery of DNA structure.
- Explain how Watson and Crick used model building to determine the structure of DNA.

2.6.NOS Using models as representation of the real world- Crick and Watson used model making to discover the structure of DNA.

- List types of models used in science.
- State a common feature of models in science.
- List ways in which models are different from the structure or process it represents.

7.1.A1 Rosalind Franklin and Maurice Wilkins' investigation of DNA structures by X-ray.

- Outline the process of X-ray diffraction.
- Outline the deductions about DNA structure made from the X-ray diffraction pattern.

7.1.NOS Making careful observations- Rosalind Franklin's X-ray diffraction provided crucial evidence that DNA is a double helix.

- Describe Rosalind Franklin's role in the elucidation of the structure of DNA.

DNA Structure: Checking your understanding. Using your DNA nucleotide models, work through the following questions.

1. Draw a deoxyribose sugar, numbering the carbon atoms.

2. In your own words, what do 5' and 3' mean?

3. What is a nucleotide?

4. What are the three parts of a nucleotide?

5. Draw the structure of a nucleotide.

6. What are the two types of pentose sugars that are found in all nucleotides? Sketch and label each, highlighting the one difference between them.

7. Contrast the structure of pyrimidines with that of purines.

8. Which nitrogen bases are purines? Which are pyrimidines?

9. The nitrogen bases join together via what kind of bond?

10. What types of bond holds the DNA backbone together?

11. Which bases are able to bond to each other?

12. What is the spiral staircase shape of DNA called?

13. How many nucleotides are there per turn of the helix?

14. How was the width of DNA (known from the x-ray picture) such a clue to its structure?

15. What does “anti-parallel” mean?

16. What does complementary base pairing mean?

DNA History READINGS

A. Read: Envisioning DNA. (online pdf) and answer the following questions.

1. How old were Watson and Crick when they first met?

2. Why were proteins (and not DNA) thought to be the molecule of heredity?

3. What information was "at hand" for Watson and Crick when they began to decipher the structure of DNA?

4. What were "Chargaff's Ratios"?

5. Who were Watson and Crick's most notable collaborators?

6. Who was Linus Pauling and how was his model for the structure of DNA incorrect?

B. Read: Collaboration and Competition – Rosalind Franklin's Story (pdf online) and answer the following questions:

1. Where did Rosalind Franklin work before joining King's College?

2. Why might Wilkins and Franklin been manipulated into disliking each other?

3. How was Watson and Crick's method of determining the structure of DNA different than that of Franklins'?

4. How might Franklin's education and training limited her ability for creative thought?

C. Read the original Research Publication:
Structure for Deoxyribose Nucleic Acid (linked online)
Nature, Vol. 171, April 1953

1. Who wrote the article?

2. What two reasons did the authors give for rejecting the previously published hypothesis of Linus Pauling?

3. What general structure do the authors propose for DNA?

4. Do the two chains run in the same direction?

5. How many times does the molecular structure repeat for one complete turn? (Hint: Each nucleotide is referred to as a "residue").

6. How long is one complete turn of the helix?

7. What holds the two chains together?

8. How do the purine and pyrimidine bases always pair together? What previously discovered evidence supports this fact? Who discovered this evidence?

9. Why can't the model be constructed of ribose sugar instead of deoxyribose?

10. Who is credited for experimental evidence to support the hypothesis proposed?