



List of Learning Activities for DNA

THEME: DNA

FEATURES:

- Through providing numerous hands-on experience to help students to visualize detailed structures of DNA and hence develop better understanding towards DNA

PEDAGOGIES: Reading to learn, Peer learning (Group work)

SCIENTIFIC ELEMENTS:STEM, Nature of Science

FLOW OF ACTIVITIES:

Part I: From Chromosome to DNA	<ul style="list-style-type: none"> - Activity I ‘Toilet Paper Roll’ Model’ - Activity II Video Watching of How Scientists resolve the three-dimensional structure of DNA? (Nature of Science)
Part II: Complementary Strands of DNA	<ul style="list-style-type: none"> - Activity III ‘Making DNA Paper Model’ - Activity IV ‘Find Your Partner’ - Activity V ‘Act like Chargaff’ - Activity VI ‘My 3D DNA Model’

DETAILS OF ACTIVITIES:

ACTIVITY	KEY CONCEPT	DETAILS
I ‘Toilet Paper Roll’ Model’	<ol style="list-style-type: none"> 1. Chromosome is the tightly packed form of DNA 2. DNA coils around proteins to give chromosomal structure 	<ul style="list-style-type: none"> ✓ Distribute cut toilet paper roll and thin rope to Ss ✓ Ss should construct a simple model by having the thin rope to coil around the toilet paper roll to simulate how DNA coils around proteins in chromosome
II Video Watching	<ol style="list-style-type: none"> 1. Scientific knowledge, theory and human understanding changes from time to time (NOS) 2. Models are used in Science (NOS) 3. Spirits of scientists are demonstrated through the discoveries of DNA structure 	<ul style="list-style-type: none"> ✓ Link in ‘Reference’ section ✓ Ss realize how different scientists work out the puzzles for resolving the three-dimensional structure of DNA ✓ Ss realize scientific knowledge and understanding to the nature sharpens from time to time
III ‘Making DNA Paper Model’ (Pre-lesson Task)	<ol style="list-style-type: none"> 1. DNA composed of two strands 2. DNA is in double helical shape but not two-dimensional parallel strands 3. DNA composed of many repeating units (Nucleotide) 4. Each repeating unit comprises 3 different parts (phosphate, sugar and base) 	<ul style="list-style-type: none"> ✓ Distribute the worksheet ✓ This could be assigned as a pre-lesson task to get students prepared for the lesson in advance
IV ‘Find Your Partner’	<ol style="list-style-type: none"> 1. DNA composed of two strands 2. The two strands are complementary to each other 3. The two strands are in anti-parallel fashion 4. DNA is made up of repeating units 5. Four types of bases make up DNA 6. ‘A’ always pairs up with ‘T’ and ‘C’ always pairs up with ‘G’ 7. Amount of ‘A’ always equal to that of ‘T’ and ‘C’ always equal to that of ‘G’ 8. Same type of bases (i.e. ‘A’ and ‘A’) would not pair up with each other 9. Mis-matching bases would not form strong and stable attractions and hence not pairing up 	<ul style="list-style-type: none"> ✓ Make up FOUR different coloured cards representing four different types of bases ✓ Distribute one card for EACH Ss randomly ✓ Ss with ‘A’ and ‘T’ hang out their right hands ✓ Ss with ‘C’ and ‘G’ hang out their left hands ✓ Ss pair up with each other who hang out the same type of hands of opposite colour ✓ After pairing up, Ss use other hands to form links with other pairs ✓ Some Ss would not be able to pair up <p>All Ss participate in the activity Teacher takes pictures and shows them on the projector Use pencil to highlight</p>

<p style="text-align: center;">V ‘Act Like Chargaff’</p>	<ol style="list-style-type: none"> 1. ‘A’ always pairs up with ‘T’ and ‘C’ always pairs up with ‘G’ because of corresponding no. of attraction forces can be formed 2. Same type of bases would not pair up with each other although same number of attraction forces in order to maintain constant width of DNA/ distance between complementary strands 3. Amount of ‘A’ always equal to that of ‘T’ and ‘C’ always equal to that of ‘G’ 4. Realize the importance of Chargaff’s finding towards the successful construction of 3D DNA model by Watson and Crick (NOS) 5. Realize the limitation and purpose of using models in Science (NOS) <p><i>*Ss deduce Chargaff’s rules through this activity</i></p>	<ul style="list-style-type: none"> ✓ Distribute TEN cards printed with FOUR different bases to each group of Ss (2 A, 2 T, 3 C, 3 G) ✓ Ask Ss to form a DNA model by: <ul style="list-style-type: none"> (i) pair up bases (ii) join the base pairs together to form a continuous structure ✓ KQ1: Why ‘A’ only pairs up with ‘T’ and ‘C’ only pairs up with ‘G’? ✓ KQ2: Why the same type of base would not pair up with each other? ✓ KQ3: How would you comment the amount of base in a DNA sample?
<p style="text-align: center;">VI ‘My 3D DNA Model’ (Follow-up Task)</p>	<ol style="list-style-type: none"> 1. The model should show the DNA making up of 2 anti-parallel complementary strands 2. The model should show the DNA in the shape of double helix 3. The model should show the DNA with 1 complete turn with 10 base pairs 4. Adenine always pairs up with Thymine and Cytosine always pairs up with Guanine 5. The model should show nucleotides as the basic units of DNA 6. The model should show the detail parts of a nucleotide (i.e. Base, sugar and phosphate) 7. The model should show correct attraction forces in complementary base pairs. (i.e. 2 attraction forces are found between Adenine-Thymine base pair while 3 attraction forces are found between Cytosine-Guanine base pair) 	<ul style="list-style-type: none"> ✓ Distribute the Ss Guideline ✓ Require Ss to construct a scientifically accurate 3D DNA model to summarize their learning in DNA structure

REFERENCES:

1. Activity II - Video Watching ‘Discovery of three-dimensional structure of DNA’:
https://www.youtube.com/watch?v=1vm3od_UmFg
2. Activity III – ‘Making DNA Paper Model’
https://cdn.rcsb.org/pdb101/learn/resources/dna-model-2013_2.pdf
3. Activity IV – ‘Find Your Partners’
<https://extension.purdue.edu/4h/Documents/Volunteer%20Resources/AS-DNABasePairingActivity.pdf>