Class: Grade 12 Biology

Lesson Title: DNA Structure & Replication Kinulation

Class Size: **24**
Time: **60 mins**

Curriculum Outcomes:
315-5 Explain the current model of DNA replication.

Learning Objectives:
1. Students will understand the structure of DNA and the process of DNA replication
2. Students will be introduced to the proteins helicase and DNA polymerase
3. Students will understand directionality of DNA polymerase and DNA strands.

Materials:
- Nucleotide cards that are cut in a way so that only A&T and C&G will fit together
  - Make sure the cards have an A, T, C or G written on them and that they have an arrow with the tail at 5` and the head at 3`
- DNA Polymerase nametag with string
- Helicase nametag with string

Preparation beforehand:
- Make nucleotide cards and all name tags for students. Be sure to have enough nucleotides for the whole class and make sure that all cards given out have a match (ex: all A's have a T to pair with and all C's have a G to pair with)

Introduction:
- Introduce the topic. Possible prompt questions include:
  - What is DNA? What makes up DNA?
  - What are nucleotides? What is their role?
  - How does DNA replicate itself?

- Explain what a kinulation is (broken up into kinesthetic and simulation). Tell them that these are used to help students learn difficult concepts that are otherwise difficult to picture. It allows students to become part of the demonstration, and therefore easier to remember and learn. Ask students if they would like to try one.

Activity #1 – DNA Structure:
1. Hand out nucleotide cards to all students and tell them they are going to represent DNA with their cards they were given and themselves. Choose an area in the classroom and get them to stand in a line to organize themselves.
   a. Do not give specific instructions, let the students try it out and talk to one another to figure it out.
   b. Students should be in two lines, facing each other in paired nucleotides.

2. Ask students what the letters stand for on their card (Adenine, cytosine, guanine and thymine)
   a. Ask them what the thought of when you asked them for form a DNA structure with their cards, why did you choose to line up this way?
   b. Could your "C" card fit into a "T" card? An "A" card? What about your "T", does it fit with a "C" ir "G"?
   c. Show students a diagram of the DNA double helix to show what they are simulating. What do your bodies represent? (the backbone). What do the cards on the inside represent that you're holding? (nucleotides—the building blocks of DNA).

Activity #2 – DNA Replication:

1. Ask students to take a closer look at their nucleotide cards. What else do you notice about them? What do the arrows and numbers mean? (It shows directionality, each strand goes in a different direction)
    a. Why do you think this is important? Think in terms of DNA replication.

2. Next, ask half of the class to stay in their lines as paired nucleotides and have the other half stand off to the side in a "pool" of nucleotides (free floating nucleotides)

3. Ask for a volunteer from the nucleotide pool to be a special protein. They will play the role of helicase.
    a. Ask if anyone knows what the protein helicase does (helicase "unzips" or cuts in half the two strands of DNA).
    b. Ask the student who is helicase to run through the middle of the DNA strand and ask the students who are paired and still holding the nucleotides to take a step back as helicase goes through.
    c. Tell students they have just completed step 1 of DNA replication!

4. Next, ask for a second volunteer from the nucleotide pool to play the role of another protein. This student will be DNA polymerase.
    a. Ask students if they have any ideas of what this protein does. If we want to replicate the DNA, what do you think the role of this protein is? (It brings free nucleotides to the "unzipped" strands to create two new strands of DNA).
    b. The student who is DNA polymerase will go stand next to one of the strands of DNA and call out what nucleotide is needed (Ex: If standing next to a "G" the student would say "I need a "C"" and a student from the nucleotide pool with a "C" would come stand and pair with that "G")
    c. Ask studnets if they think they were added in a certain direction? (DNA polymerase only works in a certain direction, 5` to 3`, not backwards).
    d. There should now be 4 lines of students, or 2 double stranded DNA structures with paired nucleotides.

5. Ask students to look at their 2 new strands of DNA they just created. What do you notice about them? What is similar or different than before? (they keep one of the original strand, they are complimentary).

Conclusion – Possible wrap-up questions:

1. Where do the nucleotides come from that are added to the strand of DNA by DNA polymerase?
2. Where do DNA polymerase and helicase proteins come from?
3. What is the purpose of the 5` to 3` end?