

TITLE OF LESSON

Biology Unit 1 Lesson 27 – DNA Replication and Repair, and *The Double Helix*  
*How do cells store and transfer information?*

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TIME ESTIMATE FOR THIS LESSON

One class period

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ALIGNMENT WITH STANDARDS

California – Biol CB 1d; G4 & G5a-b

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MATERIALS

**DNA Sequences** – Student Page  
**DNA Sequences Key** – Teacher Page  
**Evaluation Essay #1 Requirements** – Student Page  
**Evaluation Essay Rubric** – Student Page  
**Blank Circle Diagram** – Student Page  
**Circle Diagram for Essays Instructions** – Student Page

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LESSON OBJECTIVES

- To learn about DNA replication and reparation
  - To learn how to replicate DNA on paper
  - To write an evaluative essay on their outside reading assignment *The Double Helix*
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FOCUS AND MOTIVATE STUDENTS – WARM-UP ACTIVITY

- 1) Homework Check – Hand back their graded analysis of Messelsohn and Stahl Experiment. Collect all homework assignments.
  - 2) **Agenda** – Have students copy the agenda you posted.
  - 3) DNA Replication – In groups, have students decide if they think DNA is replicated. If yes, have them explain why, when, and how. If no, ask them to explain why not. Give them a couple of minutes to come up with their answers. As a group, they will present their ideas and a student will write their comments on the board.
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ACTIVITIES – INDIVIDUAL AND GROUP

1. **Note Taking** – Tell the students that they will be responsible for listening and taking good notes. Although you will be asking them questions and they will be discussing ideas as a class, they should take out a piece of paper, title it DNA Replication, and take notes on all of the important points talked about in class. Remind them to underline the new vocabulary they encounter, as they will be responsible for learning it. Appoint a class notetaker and have her come to the overhead. Have some visuals of DNA replication handy from the class textbook or the Biology web site, <http://gened.emc.maricopa.edu/Bio/BIO181/BIOBK/BioBookDNAMOLGEN.html>
2. **Discuss and Explain** – Discuss why it is important that the cell create an EXACT replica of the DNA. Can the students come up with a few reasons? Write their ideas on the board. Ask when it would be important or beneficial to have a few errors. Write these ideas on the board as well. Explain that there are two anti-parallel strands together, but the cell wants to copy the strands. How is the cell going to do that? First, the cell needs to separate the strands. How does the cell do that? It has a special enzyme called a *helicase*. This enzyme is like a one-way zipper; it only opens. Once the strands are open the DNA polymerase attaches complementary bases to the template and DNA ligases join any fragments. The two strands or templates of a helix are anti-parallel, but the polymerase can only read in one direction (5' to 3'), therefore it is necessary to copy the 3' to 5' strand in small segments called Okazaki fragments. The DNA ligase joins these fragments. There is another important protein called topoisomerase. It is an enzyme that unwinds the DNA, which is important because it is a helix and not a straight chain. The strands of DNA would end up being a big tangled mess if this protein didn't unwind it. Use the following demonstration to make sure they really understand the problem of unwinding DNA. Take a necklace or chain that is closed. Wind it up a bit and then take your finger and move it in-between the two strands from the top toward the bottom. The more you move your finger the tighter the twist in the chain becomes until you can't slide your finger any further. This is

essentially what would happen to your DNA if the topoisomerase didn't cut one or both of the strands to allow it to unwind.

3. DNA Sequences – Give students copies of the **DNA Sequences** handout. Have the students act as DNA polymerases that copy both strands; i.e. they write the sequences on paper. They must separate the strands by writing them in two different areas and then putting the complementary bases next to the appropriate base in the strand. This exercise is simple but each student must remember that A is the compliment of T and C is the compliment of G. They must remember later that in replication they use A with T and T with A, but in transcription it will be A with U and T with A. So don't let them slack off here. Use the DNA Sequences Key found in the Teacher Pages section of this unit to review the answers with students. Before you give the answers, ask for volunteers to give their answers. Be sure to ask how they came up with their answers. Give the correct answer to each sequence and have students correct their own papers. If they came up with an incorrect answer, ask them to write why they believe the came up with the answer to begin with on their paper. Collect all handouts.
  4. Discuss and Explain – Continue with your lecture/discussion. What happens when there is an error? While the DNA polymerase is reading and adding bases, it occasionally adds an incorrect base. It can reverse and remove the incorrect nucleotide, then start reading and adding bases again. The DNA ligase joins the fragments. If there is an error that wasn't caught, the incorrect bases are removed and the polymerase can insert the correct ones. In a sense, this is like typing a document. When you make an error, you use the backspace button to remove it and add the right letter. If you don't catch the mistake as you type, you can go back later, put your cursor by the error and use delete or backspace to eliminate the mistake and then type the correct word.
  5. **Applaud/Critique** the note taker for the day.
  6. **Portfolio** – Hand back students' graded Lab Report #2. Have them look at the grade they earned. Have them place their Lab Report #2 in their **Portfolios**. They will be using this Lab Report to help them goal set for their next Lab Report.
  7. Double Helix Discussion – Have students take out their notes for *The Double Helix*. Briefly discuss the viewpoints/opinions of Watson, Crick and Wilkins in relation to Rosalind Franklin. What did they believe? Why? How did she act? Why? She was one of the first women to work in this area of science. How do you think that fact and the "times" affected her relationships? Do you think it is better for women in science now than in the past? Why?
  8. Evaluation Essay – Tell students they will be writing an Evaluation Essay about *The Double Helix*. Hand out **Evaluation Essay #1 Requirements** sheet to each student. Review the requirements with them.
  9. **Goal Setting** – Hand out the **Evaluation Essay Rubric**. Have students decide which grade they would like to shoot for in this first essay. Ask them to write their name at the top of this rubric and circle the grade they are aiming for. Tell them they will be turning in their rubric with their essay when it is complete. For now, they should keep their rubric with them while they are writing their paper so they can make sure they have met all the requirements for the grade they wish to receive.
  10. Outline an Essay – Tell them they will be filling in their **Circle Diagram** tonight for homework. Hand out a **Blank Circle Diagram** and a **Circle Diagram for Essays Instructions** sheet. Field all questions. If there is time left in class, have them start their **Circle Diagram**.
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#### HOMEWORK

Fill in your Circle Diagram according to the instructions on your **Circle Diagram for Essays Instructions** sheet.

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#### GROUP ROLES

None

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#### DOCUMENTATION FOR PORTFOLIO

Lab Report #1  
Method – Photoshop Image  
Lab Report #2