

TITLE OF LESSON

Biology Unit 1 Lesson 36 – Recombinant DNA Technology Continued:
DNA Sequencing, PCR and DNA Fingerprinting
How does man control what's on the inside and outside of a cell?

TIME ESTIMATE FOR THIS LESSON

One class period

ALIGNMENT WITH STANDARDS

California – Biol CB 1; G5c-d

MATERIALS

DNA Sequencing Gel – Student Page
DNA Sequencing Gel Key – Teacher Page
DNA Fingerprint Starr 15 7 – Student Page (Image of PCR and DNA fingerprinting, figure 15.7 from Starr's *Biology Concepts and Applications* p. 227)
Lab 7: DNA Isolation Protocol – Student Page
Teacher's Notes Lesson 36 – Teacher Page

LESSON OBJECTIVES

- To learn about DNA sequencing and its function
 - To understand how to amplify DNA fragments or genes by polymerase chain reaction (PCR)
 - To understand how amplified DNA fragments can be used (for example, DNA fingerprinting)
 - To develop the skills necessary to create their own experiments
 - To review with their group members the DNA sequencing and how it fits with their final project murder scene
 - To demonstrate mastery of the process and function of a cDNA library
-

FOCUS AND MOTIVATE STUDENTS – WARM UP ACTIVITY

- 1) Homework Check – Hand back all graded assignments. Initial all completed posters.
 - 2) **Agenda** – Have students copy the agenda you posted.
 - 3) Present Posters – In their groups, have students present their posters. Tell them they must explain to their group members only how the process of their cDNA library works and how the visual they have created demonstrates that. Ask for volunteers in each group to go first. When each group has raised their hands, tell them they will have 2 minutes to explain to their group how their poster works. Tell them to start. At the end of 2 minutes, call time. Ask that presenter if they would like to go to their right or their left. Whichever they choose, the person sitting to the right or left of them must present next. Tell them they will have 2 minutes to present. Continue in that same direction until all students have presented.
 - 4) Most Effective Poster – Then ask the group to take one minute to decide which poster they think was the best representation of a cDNA library and why. Tell them the person who created the poster will present the poster. Then you will randomly call on someone else in the group to explain why their group felt it was the best. So everyone had better be prepared to present. At the end of the presentations, collect the posters for credit. When you have finished grading them, post them in the room.
-

ACTIVITIES – INDIVIDUAL AND GROUP

1. **Mind Web** – Post the words HUMAN GENOME PROJECT in the center of the board. Have the students do a **Mind Web**, which is a collection of words with circles drawn around them and lines that shoot off to other words and phrases. This is another form of brainstorming. A student can volunteer to write the **Mind Web** on the board while the teacher facilitates the activity. They can add words that describe what the human genome project is,

what the goal of the project is and why it is being done. Here's some brief info: it is a project to sequence all of the chromosomes in humans. It is felt that it will lead to new cures for many genetic disorders. What else do you think can be done with this information? Maybe it will be used to test your abilities, or your propensity to get a disease when you are applying for a job. Discuss this very briefly, then start the activities about how one sequences DNA.

2. Lecture – Present the key points on DNA sequencing in **Teacher's Notes Lesson 36**. Show an image of how sequencing is done. There is an example in fig. 15.8, p. 228 in Starr's *Biology Concepts and Applications*. Choose a class note taker for the day. The class note taker will write the notes for the day on the overhead.
3. Pair Work – Hand out copies of the **DNA Sequencing Gel** handout. Make sure each student receives a copy. Have the students work in their assigned pairs to read and interpret the DNA sequences. Remind them that in order to read a sequencing gel, you must start from the bottom and work your way up. Tell them that although they will be working with a partner to figure it out, they must write their findings on their individual handouts. Give students ten minutes to complete their handout.
4. Peer Grading – At the end of ten minutes, call time. Ask students to switch papers with someone other than their partner. Tell them they will be correcting each other's paper. Ask for a volunteer to read the answer on the sheet they are correcting. Take the answer and discuss whether or not it is correct. Look back over it to figure out why they made the mistakes they made, if they made any. Allow students to volunteer what went wrong before you give any answers. Then take questions from students about other answers given and whether or not it is correct. When all questions have been answered, tell students they will need to understand how to do this in order to create their own sequence for their final project. If they mess it up, their project will not work. So tell them to make sure to ask any questions now. Then have them sign their name, corrected by... Collect all handouts to be graded tonight.
5. **Group Brainstorm** – Have the students work in their groups to brainstorm about DNA fingerprints. They must come up with their definition of a normal fingerprint and then try to determine what a DNA fingerprint is. Can they explain what a DNA fingerprint is? Can they explain what it is used for? Give them 10 minutes to work on the activity. Then select a student to write the brainstorming ideas on the board.
6. Lecture 2 – Continue presenting the key points on PCR and DNA fingerprinting in **Teacher's Notes Lesson 36**. Have the note taker continue taking notes.
7. Identifying Suspects – Show image of figure 15.7 from Starr's *Biology Concepts and Applications* p. 227. For this image, you need seven suspects. Use the names of students in your class to create a fictitious murder mystery for the lecture. For explanation's sake, the following names are listed here, but it will be more entertaining for the students when you use their names to explain the DNA fingerprint. For example, a student Mark is accused of murdering a student Tom. Mark claims he is innocent. Jill, Joel, Dan, Sarah, Bob, and Marcia, other students in the same class, are also suspects. All give blood samples that are used to make DNA fingerprints. Mark's DNA is represented by the DNA fragments in lane number 1, Jill lane 2, Joel lane 3, Dan lane 4, Sarah lane 5, Bob lane 6 and Marcia lane 7. Ask the students to identify which person is the criminal by analyzing the DNA fingerprint. Ask them how they would figure it out. They should know that the DNA fragment pattern that matches that of the one found at the crime scene, DNA from Tom's blood, indicates that this person is a suspect. Then go over how the students can solve this. For example, lanes 1, 2, 3, 4, 5, 6, and 7 contain the suspect DNA for Mark, Jill, Joel, Dan, Sarah, Bob, and Marcia, respectively, and the lane labeled from blood at crime scene is that of the DNA from Tom's blood from the crime scene. Remind students that they only need to find the DNA sample that matches the one from the crime scene. If they look closely they will observe that the DNA fragments from lane 3 and those from the blood at the crime scene match, i.e. they have identical bands. Should Mark go free or is he the murderer? Yes, Mark should go free since Mark's DNA (in lane 1) did not match that of the crime scene. Joel's DNA (lane 3) matched and is more likely to be the murderer.
8. Discuss – Once the students understand how a suspect's DNA matches that of the suspected murderer, talk about the use of DNA fingerprints in crime cases. Ask them why it could be possible to have a "DNA match," i.e. DNA found at the crime scene that matches one of the subjects', yet, not definitive proof that the suspect is

the murderer. Thus, finding DNA at the crime scene isn't sufficient proof of guilt. Let the students come up with ideas about why the DNA fingerprint wouldn't be sufficient proof. Have a volunteer write their ideas on the board. They should come up with something like the following:

- a) It may be circumstantial evidence, i.e. the person was at the crime scene but not at the time of the murder.
- b) The blood sample at the crime scene is contaminated with other blood sample(s).
- c) The DNA Fingerprint gel samples got mixed up or were labeled unclearly so the gel is not depicting the correct suspect.
- d) Even though the gel suggests that the person is the murder, they may have hard evidence that they were in another place. For instance, they could have been giving a lecture in another state and were seen by many people.
- e) Possibly a blood sample from a person may indeed have been on the crime scene, but maybe it was from the day before the crime and happened to be in the same place.
- f) Maybe this person is a twin (one who knows or doesn't).

There could be many reasons that the DNA fingerprint is not conclusive. The main point here is that the students understand that even though the images they are using to understand the concept are clear-cut, it doesn't mean that in real life it is so easy to read a DNA fingerprint. Then mention to them that they will be creating a crime scene for their final project. They should keep this fact in mind when they create their crime scene and when they are solving another group's.

9. Crime Investigation and Scientific Method – Ask the class how an experiment utilizing the scientific method and a criminal investigation are alike. Ask a volunteer to write their ideas on the board. All students should be writing these ideas in their notebooks, as they will need them to formulate how to solve another group's murder mystery. They should come up with ideas like the following: logical thought process is required, getting all the facts or information is important, drawing conclusions based on the information available, don't include personal bias only facts, drawing information from all sources whether from class, experiment or previous knowledge, discussing the information within the group to obtain all possible outcomes, etc. Tell the students that they will be required to use their analytical skills in a scientific fashion to solve a crime during their final project.
10. **Applaud/Critique** – At the end of the lecture/discussion, **Applaud/Critique** the note taker.
11. **Vocabulary** – Write the vocabulary words below on the board. Take 5 minutes to have the students write the new vocabulary words in the vocabulary section of their binder. Ask them to look up the definitions and write them in the notebook. Tell them they will need this vocabulary for the next step in this lesson in order to define different aspects of the sketch they will be making. DNA sequence
modified nucleotides
DNA polymerase
primer
normal nucleotides
DNA fingerprint
polymerase chain reaction (PCR)
12. Lab 7: Graphic Organizer – Hand out **Lab 7: DNA Isolation Protocol**. Tell students they will be creating their own graphic organizer for the lab protocol for tomorrow. Briefly review with them what a graphic organizer is (a visual to organize your ideas). Some examples of graphic organizers are the **Venn Diagram**, the **Circle Diagram**, the **Plot Diagram**. Ask if they can think of any others. Tell them they will be creating a graphic organizer that applies the scientific method to this lab. In the past, they had this done for them by the teacher or in a textbook. Tonight, they will use their scientific minds to create their own. Ask them to quickly brainstorm what the structure of their graphic organizer must contain. Their answers should include: room for their starting question, their original hypothesis, the protocol they will use to conduct the experiment and why, the actual steps of their experiment and the results for each, their conclusions, new questions that develop because of the results of their experiment, a new hypothesis if the results indicate their original hypothesis was wrong. Tell them to be creative in the visual structure of the scientific method when they design their organizers tonight, but

to remember that the visual structure organizes the scientific content in a way that makes sense. If there is time, let them get started in class.

13. Homework Review – Explain the rest of their homework assignments.

HOMEWORK

- 1) Read Starr's *Biology Concepts and Applications*, chapter 15, pp. 226-228. If using another textbook make sure they read about the following topics: DNA sequencing, PCR and DNA fingerprinting. Have students list the key points from the reading.
 - 2) Create your graphic organizer for **Lab 7: DNA Isolation Protocol**.
-

GROUP ROLES

Manager – The manager will hand out the **DNA Sequencing Gel** handouts

DOCUMENTATION FOR PORTFOLIO

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