Biotechnology

DNA fingerprinting
Grade 12
By : Talal Hedab.

Video sections
Section 1

Olive propagation problem

In the first section

At first, I want to tell you some information about olive tree, and its propagation.
Do you know:

- **((Olive (*Olea europaea* L.) belongs to the genus of Oleaceae family. It is a long-living diploid (2n = 46) tree with a large number of varieties.**
- **In the past , cultivation of olive trees for oil extraction is one of the most ancient tradition in the Mediterranean basin due to it's importance in the diet as well as burning in lamps.**
- **It is continues to be an important commercial crop through out the Mediterranean as well as one of the staples of many rural diets in the area.**
- **Problem with olive breading:**

Because of the large diversity of olive cultivars, synonyms and homonyms of cultivars names is a long-standing problem in olive producing countries worldwide.

- **To ensure that high quality products of international standard are produced, it is necessary to identify cultivars.**
- **The recognition of the cultivars by farmers has been a real problem since the certification of the variety based upon phenotypic characteristic is possible only after several years.))**

Then introduces the farmer's problem

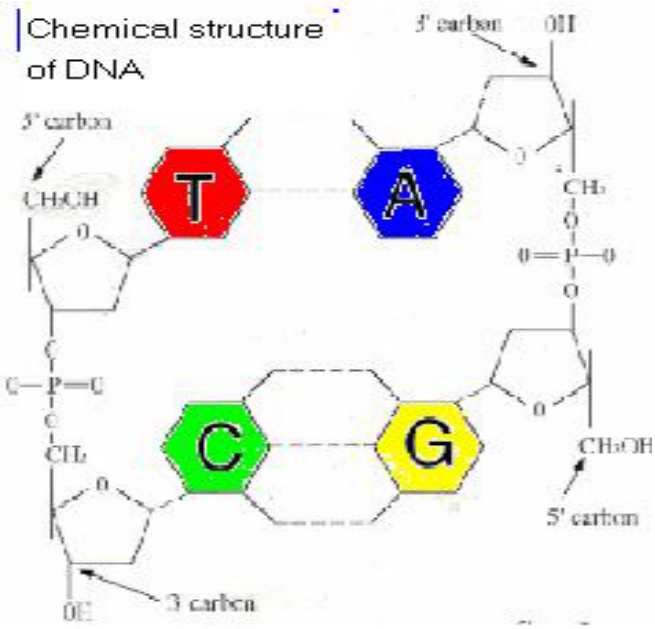
In one case a farmer have bought olive trees from the same variety, he know this variety which called "*nabali*" produce high amount of oil, but he thought may workers gave him a wrong variety, since the certification of the variety based upon phenotypic characteristic is possible only after several years.

How can the farmer identify olive cultivars before waiting 4-5 years?

Section 2

In this section we give a hint for the students about using the fingerprints as a solution by **studying the figure of DNA construct and answer questions below:**

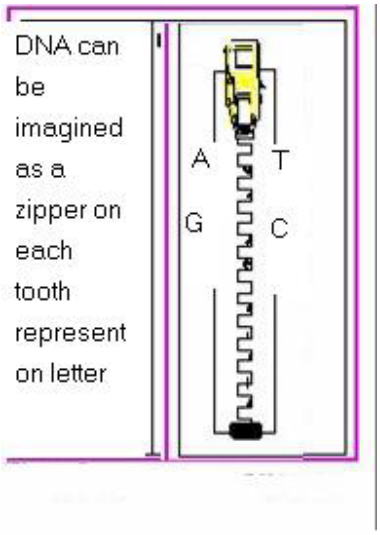
- What are the basic building blocks of DNA?
- How many strands in DNA molecule? How many kinds of nitrogenous base in DNA molecule? Chemical structure of DNA
- What are the differences of DNA molecules among individuals?
- Can you help the farmer to identify olive cultivars using your information of DNA structure?



Section 3

The third section starts by answering the previous questions.

The characteristics of all living organisms, including humans, are essentially determined by information contained within DNA that they inherit from their parents. The molecular structure of DNA can be imagined as a zipper with each tooth represented by one of four letters (A, C, G, or T) figure 2, and with opposite teeth forming one of two pairs, either A-T or G-C. The letters A, C, G, and T stand for adenine, cytosine, guanine, and thymine, the basic building blocks of DNA.



The information contained in DNA is determined primarily by the sequence of letters along the zipper. For example, the sequence ACGCT represents different information than the sequence AGTCC in the same way that the word "POST" has a different meaning from "STOP" or "POTS," even though they use the same letters. The traits of a human being are the result of information contained in the DNA code.

Living organisms that look different or have different characteristics also have different DNA sequences. The more varied the organisms, the more varied the DNA sequences. DNA fingerprinting is a very quick way to compare the DNA sequences of any two living organisms.

Then we ask the following questions :

- **H**ow can we compare the differences of DNA molecules among individuals?
- **W**hat is the mechanism of DNA fingerprinting?

Section 4

- **The fourth section starts with the historical back ground about fingerprints technology.**
- **Clarify the steps of one method used fingerprints technology**
- **Ask the students to apply this method in solving the farmer's problem .**

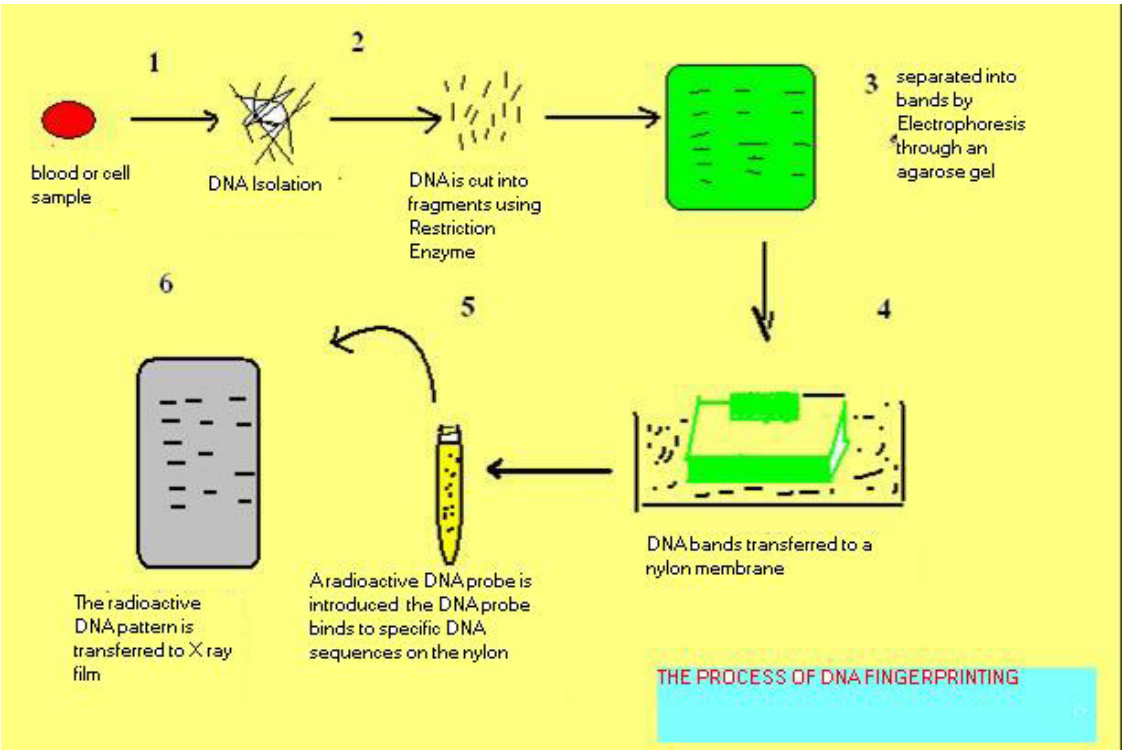
Making DNA Fingerprints

The chemical structure of everyone's DNA is the same. The only difference between people (or any animal) is the order of the base pairs. There are so many millions of base pairs in each person's DNA that every person has a different sequence.

Using these sequences, every person could be identified solely by the sequence of their base pairs, they are able to determine whether two DNA samples are from the same person, related people, or non-related people.

RFLP was one of the first applications of DNA analysis to forensic investigation. In such procedure DNA fingerprinting is a laboratory procedure that requires six steps(see figure3 below):

1: Isolation of DNA.
DNA must be recovered from the cells or tissues of the body. Only a small amount of tissue - like blood, hair, or skin - is needed. For example, the amount of DNA found at the root of one hair is usually sufficient.
2: Cutting, sizing, and sorting.
Special enzymes called restriction enzymes are used to cut the DNA at specific places. For example, an enzyme called EcoR1, found in bacteria, will cut DNA only when the sequence GAATTC occurs. The DNA pieces are sorted according to size by a sieving technique called electrophoresis. The DNA pieces are passed through a gel made from seaweed agarose (a jelly-like product made from seaweed). This technique is the biotechnology equivalent of screening sand through progressively finer mesh screens to determine particle sizes.
3: Transfer of DNA to nylon.
The distribution of DNA pieces is transferred to a nylon sheet by placing the sheet on the gel and soaking them overnight.
4-5: Probing.
Adding radioactive or colored probes to the nylon sheet produces a pattern called the DNA fingerprint. Each probe typically sticks in only one or two specific places on the nylon sheet.
6: DNA fingerprint.
The final DNA fingerprint is built by using several probes (5-10 or more) simultaneously. It resembles the bar codes used by grocery store scanners.



Now you have the steps of DNA fingerprint. Can you help the farmer to identify olive cultivars?

There are more than one technique to compare the differences of DNA molecules, what they are?

Section 5

After solving the farmer problem can we use DNA fingerprint technology to:

1. Diagnosis the inherited disorders in adults, children, and unborn babies? How?

2. Identify crime and catastrophe victims? How?

3. Detect bacteria and other organisms that may pollute air, water, soil, and food? How?

4. Match organ donors with recipients in transplant programs?

5. Determine pedigree for seed or livestock breeds?

6. Paternity and Maternity?

Can you mention other applications for DNA fingerprint?

Teacher Guide Section

The material that we're going to cover within the lesson doesn't really have many prerequisites. It just requires a little bit information of DNA structure. So it is suitable for any level at high school, also this lesson plan start with new application of DNA fingerprint, and ends with several types of applications.
The activities a that will be applied by students will be the following:

The students are given a chance to think in groups to find a solution for the problem.
Ask each group to write down the solution they suggested on the black board. Without any comments or hints from the teacher. Just share then go to the next video segment

Break 2 :

Give each group of students question to answer then give time for each group to share what they have come up with

Go to the third segment.

Break 3

Give the student the time to look for information using the internet or in books borrowed for lib.
If internet is not available you have to supply the students with books and journals about the topic.

Break 4

Ask the students to use the steps shown in the video segment no. 4 about DNA fingerprints technology to apply on the farmer's story.

Each group will share what they came up with.

Break 5

we conclude the lesson with applications and leave the chance to the students to think about; or distribute papers with samples of applications ,

each group can withdraw one paper and discuss it’s content, ask each group to give an application. or to ask the students to arrange applications according to importance.