Simulated Lab
Relationships & Biodiversity

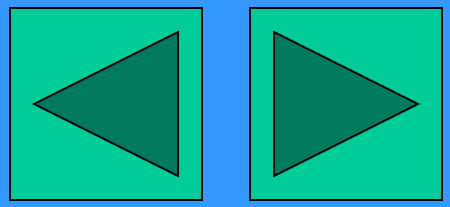
Botana curus is a valuable plant because it produces Curol, a compound used for treating certain kinds of cancer. Curol can not be produced in the laboratory.

Botana curus grows very slowly and is on the endangered species list, so its ability to provide curol in large quantities is limited.

Related Species

Species that are closely related to Botana curus are likely to produce the important substance curol. Therefore we need to identify closely related species.

Your task is to examine three species and determine how closely related they are to Botana curus.

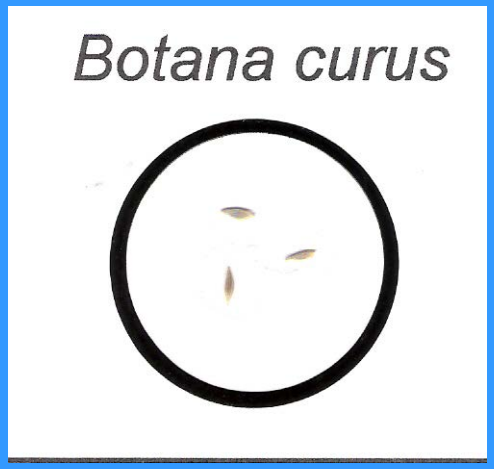


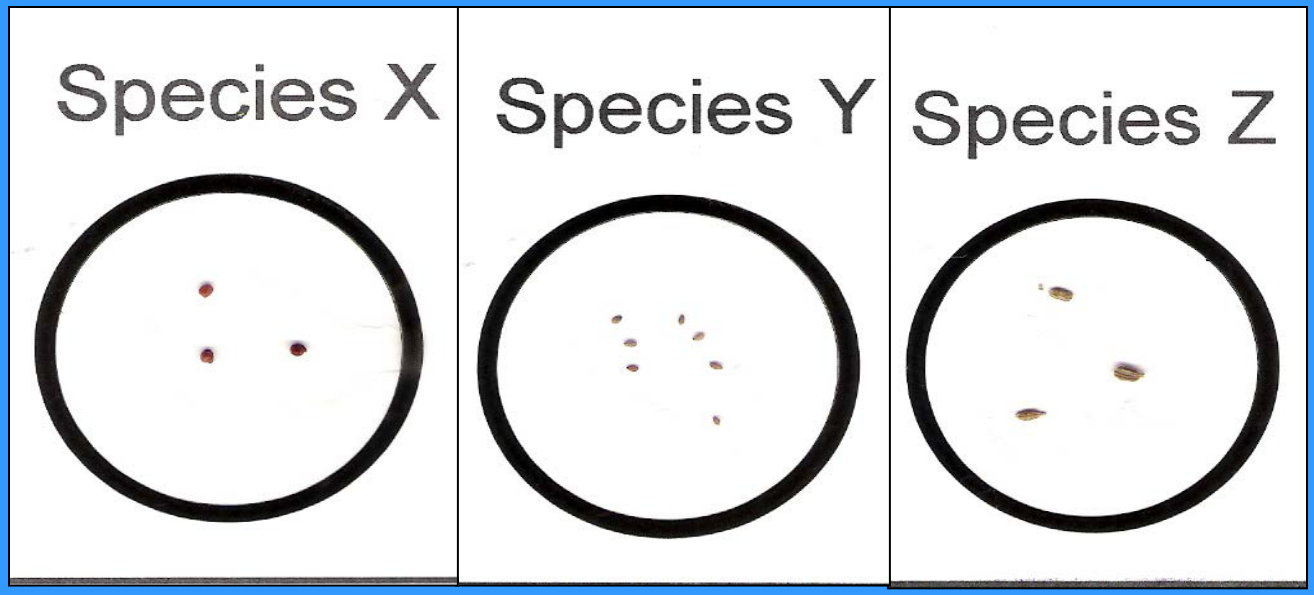
Compare Plants

Compare the structural characteristics of the plant samples.

Record your observations in Table 1.

Compare Seeds

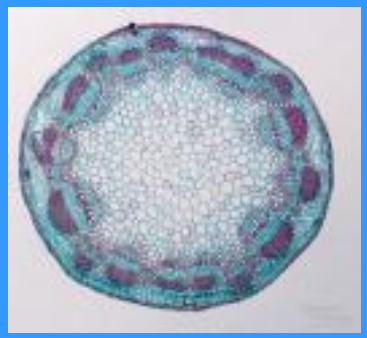




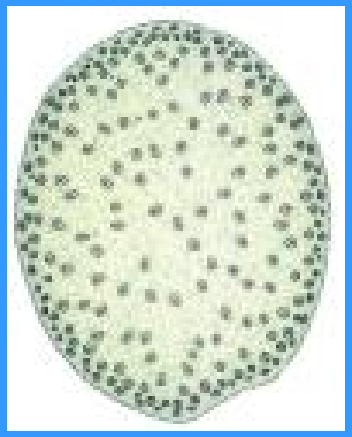
Compare the structural characteristics of the seed samples.

Record your observations in Table 1.

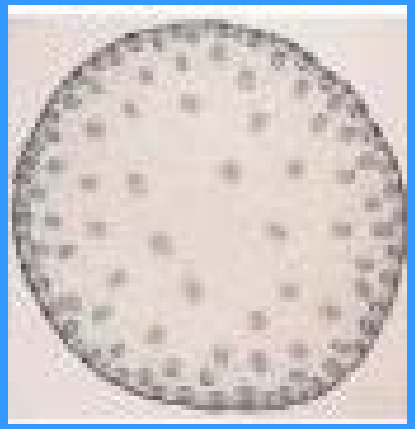
Compare Stem Structures



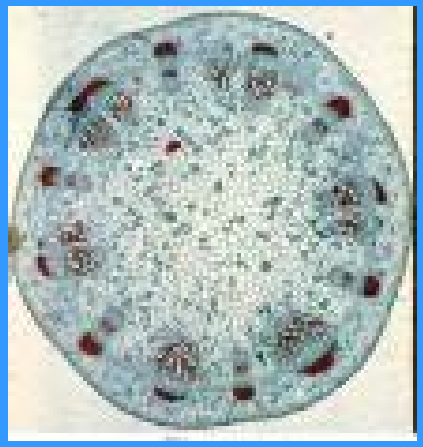
Botana curus



Species X



Species Y



Species Z

Compare the structural characteristics of the stem samples. State whether the arrangement of the bundles of conducting tissue is circular or scattered.

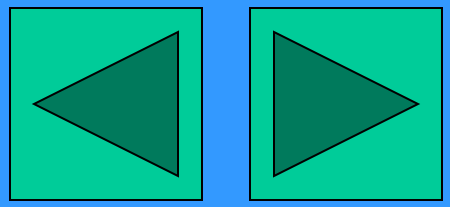
Record your observations in Table 1.

Hypothesis

Answer the following questions in your packet.

1. Based on your data for structural relationships, which species (X, Y, Z) is more closely related to Botana curus and most likely to produce curol?

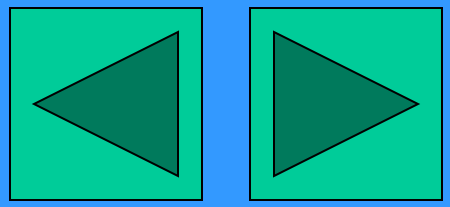
2. Explain how the evidence from your data table supports your hypothesis.



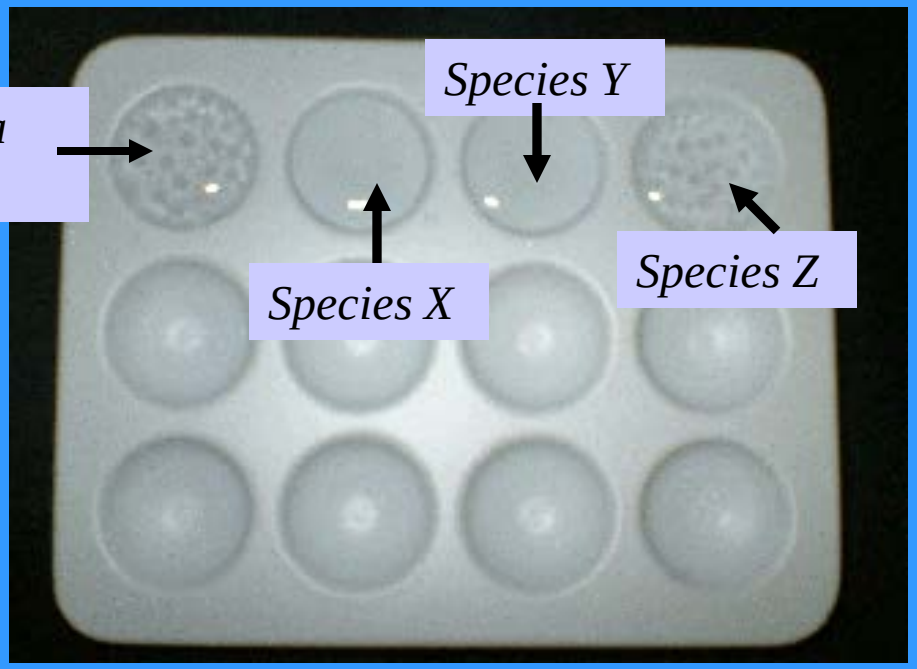
Indicator Test for Enzyme M

It is very difficult to test a plant directly for Curol. However we know that if an enzyme named “M” is present than Curol is also present.

We can test for the presence of enzyme “M” by extracting a tissue sample from each plant, and then mixing it with an indicator powder. If the reaction fizzes then enzyme “M” is present.



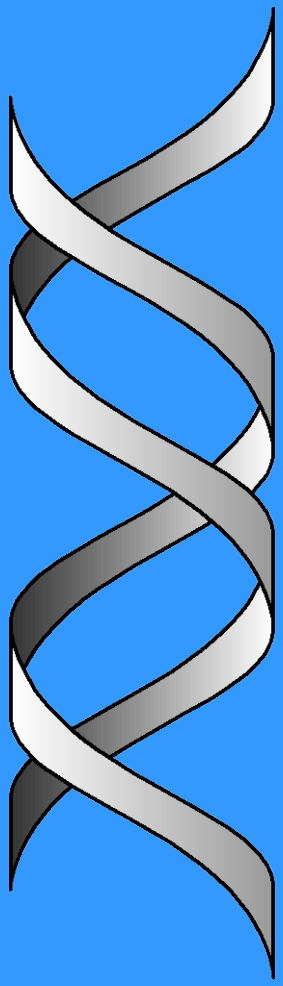
Testing for “M”



Record the results of your tests for enzyme “M”

(either a Positive or Negative result) in Table 1

DNA

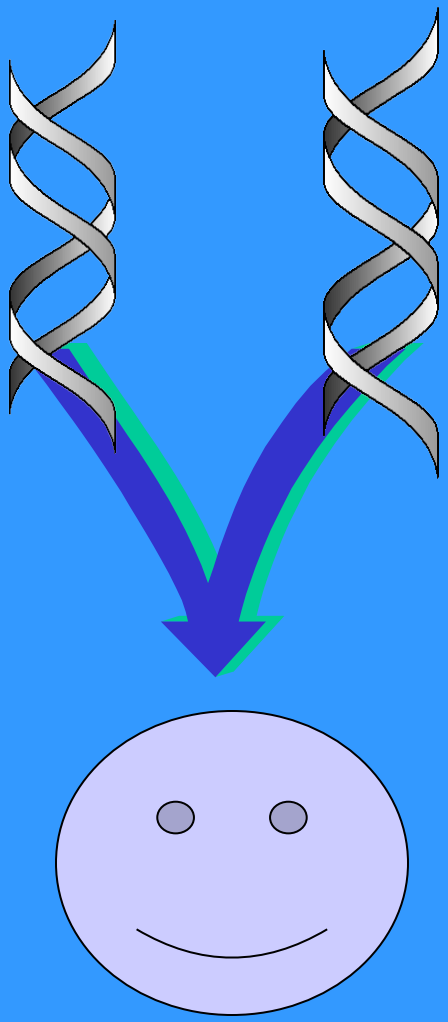


DNA is a long doubled stranded (it has two strands) molecule that contains the code (instructions) for every part of your body.

As you are unique, these codes are unique to you.

Your DNA code is like a fingerprint -it is unique only to you. This is called a DNA fingerprint.

DNA Fingerprint



About 1/2 of your unique DNA comes from your mother and 1/2 of your DNA comes from your father.

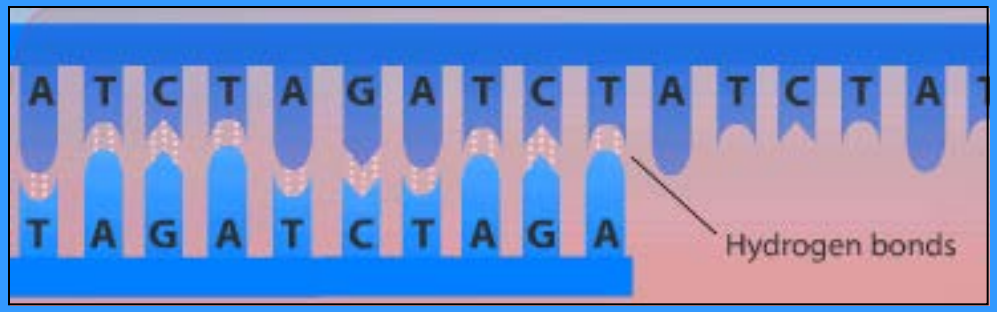
Your DNA is a unique combination of their genes.

However if we were to compare your DNA to your parents it would be similar.

Its all relative...

Scientists can tell how closely related two different people are by looking at their DNA Sequence.

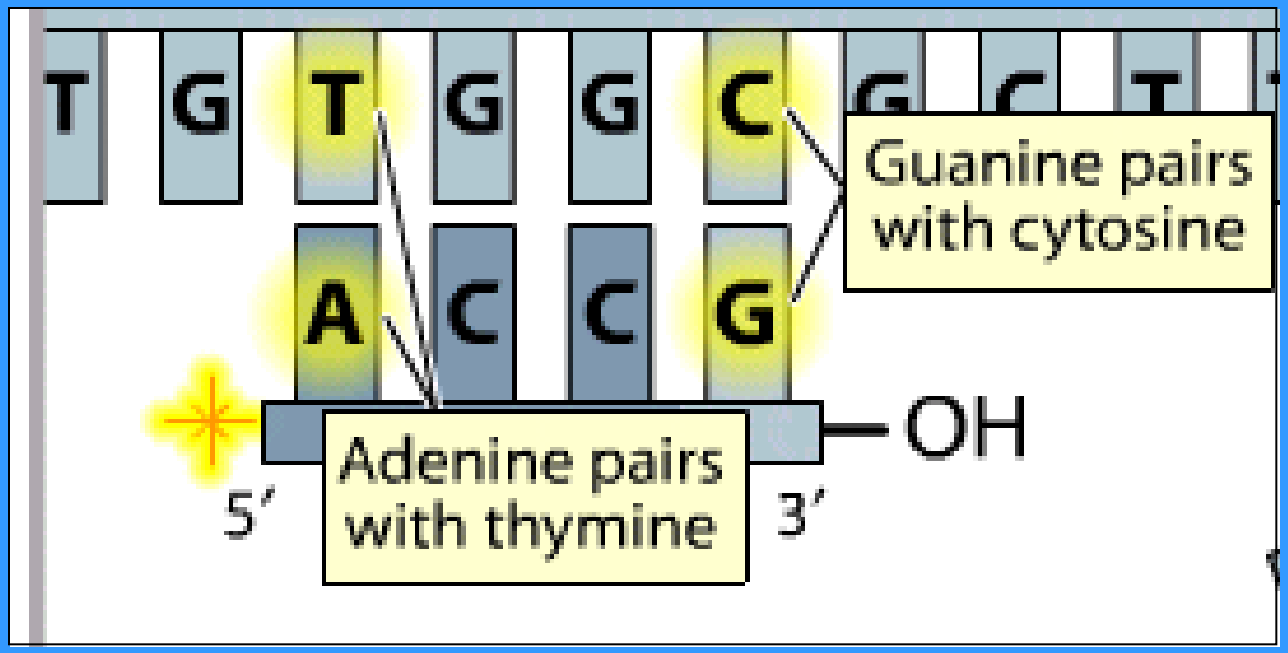
Brothers and sisters DNA sequences are very close, where as cousins DNA sequences are not very similar at all.



Remember that a DNA molecule is made up of bases that form pairs.

It is the sequence of these bases that we use to compare relatives.

Base Pairs


T
G
T
G
G
C
A
C
C
G
Guanine pairs with cytosine
Adenine pairs with thymine
OH
5′
3′

Comparing Relatives

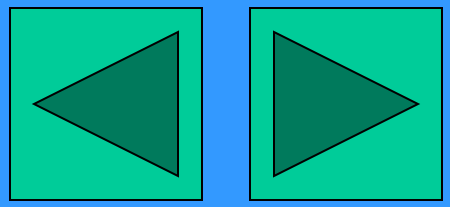
Comparing DNA base sequences is like examining words to see how similar they are.

For example look at the following words.

Synapse Samantha Symbiotic Symbol

You can order these words by how similar their spelling is.

Symbiotic and Symbol both start with ‘Symb’ synapse is pretty close and Samantha is not related at all.

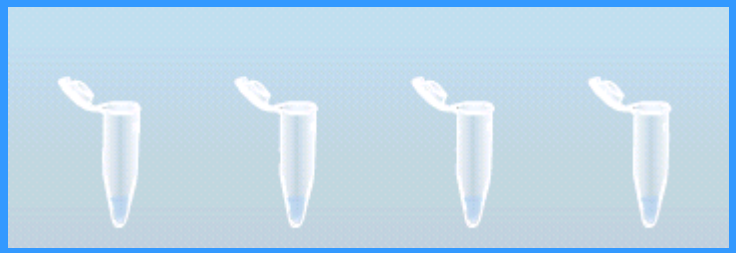


Gel Electrophoresis

Gel Electrophoresis is a technique used by scientists to determine how similar DNA sequences are to each other.

Unlike comparing words like Samantha and Symbiosis electrophoresis gels compare the sizes of DNA fragments.

The thought is, the more similar size fragments two organisms have…the more related they are.

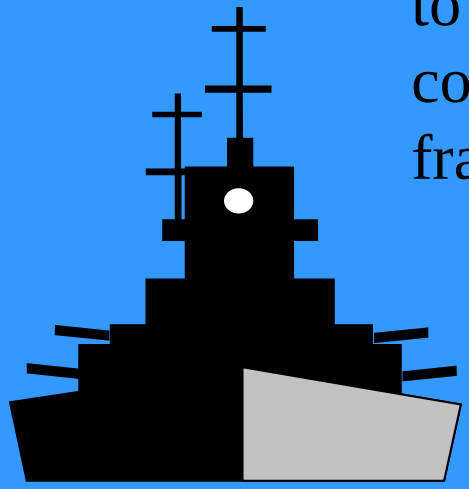


Micro Test Tubes

Relative Size

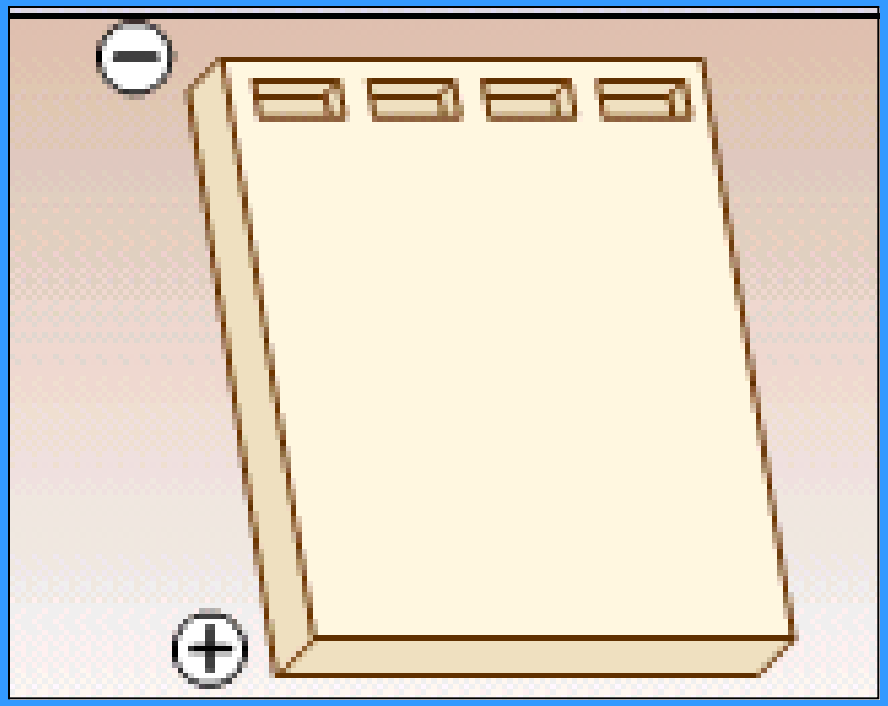
If I were to take apart several boats and line up all of the pieces for comparison. Then I compare the relative size of the rudders, bows, and decks, I could tell that two sail boats are more closely related to each other than to a battleship, based on size.

vs.



Gel Electrophoresis helps to make similar comparisons with DNA fragments.

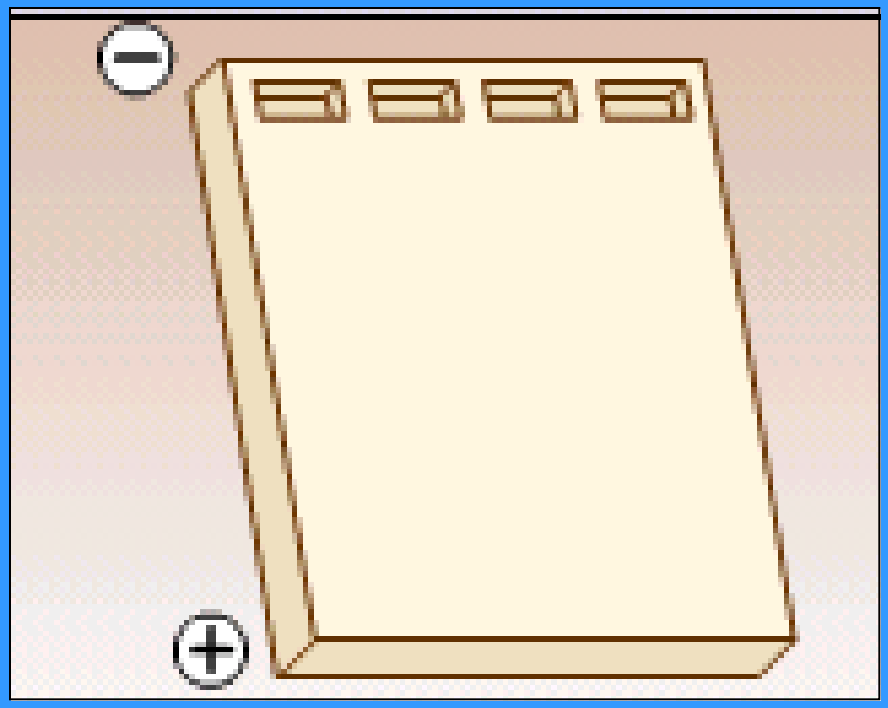
The Gel



An electrophoresis gel is made of agarose which is a sugar. It forms into a structure that is like microscopic spaghetti.

It’s the strings of sugar spaghetti that separate the different size fragments

How does it work?

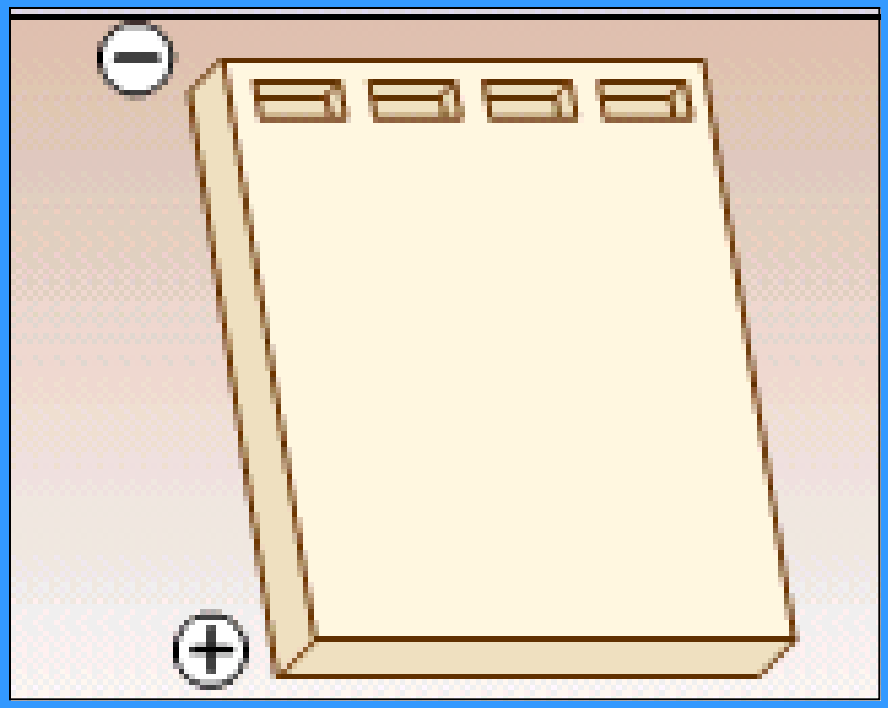


If you were in a classroom filled from the floor to the ceiling with spaghetti and I asked all of the students to run for the door-

-What would happen?

The small students would climb through the spaghetti easier than the larger students…they would get to the door 1st.

Separation of DNA Fragments

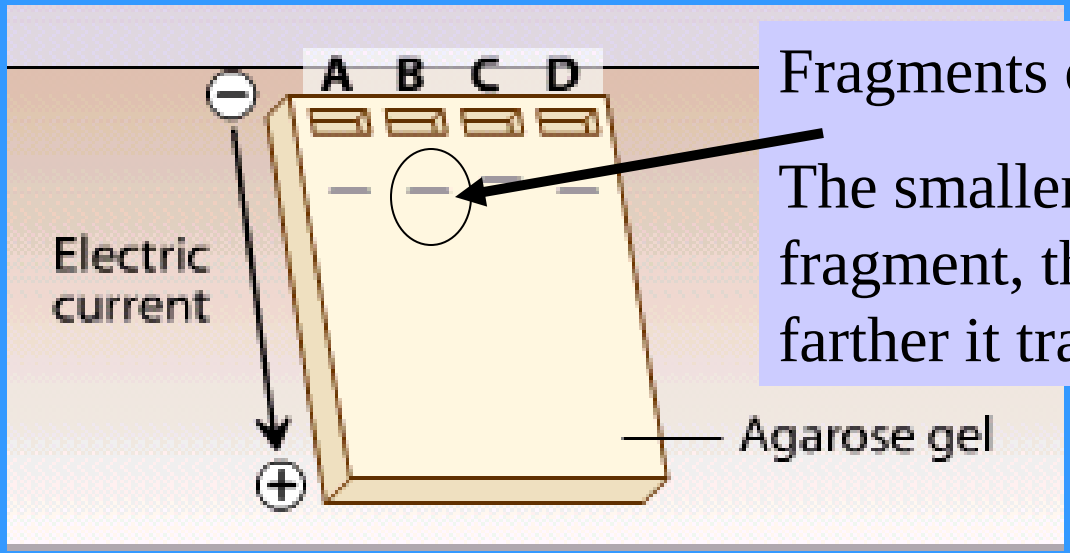


The same thing happens with DNA fragments.

We place the DNA into the agarose gel (like spaghetti) and we pull them through the gel with an electric current.

DNA is negatively charged therefore it is attracted to the positive electric current.

Separation of DNA Fragments

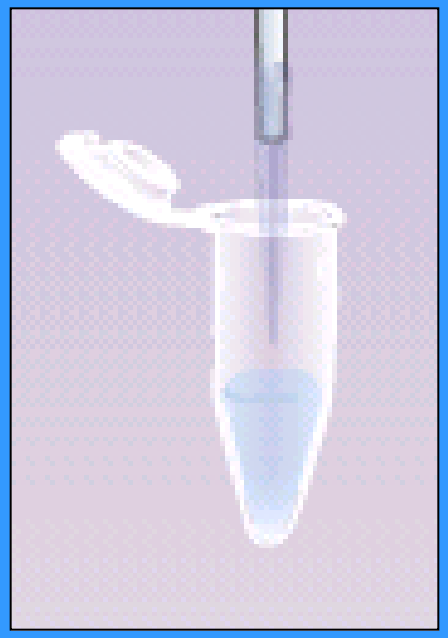


Fragments of DNA.

The smaller the fragment, the farther it travels

The small DNA fragments will fly through the gel easily and the large pieces will lag behind.

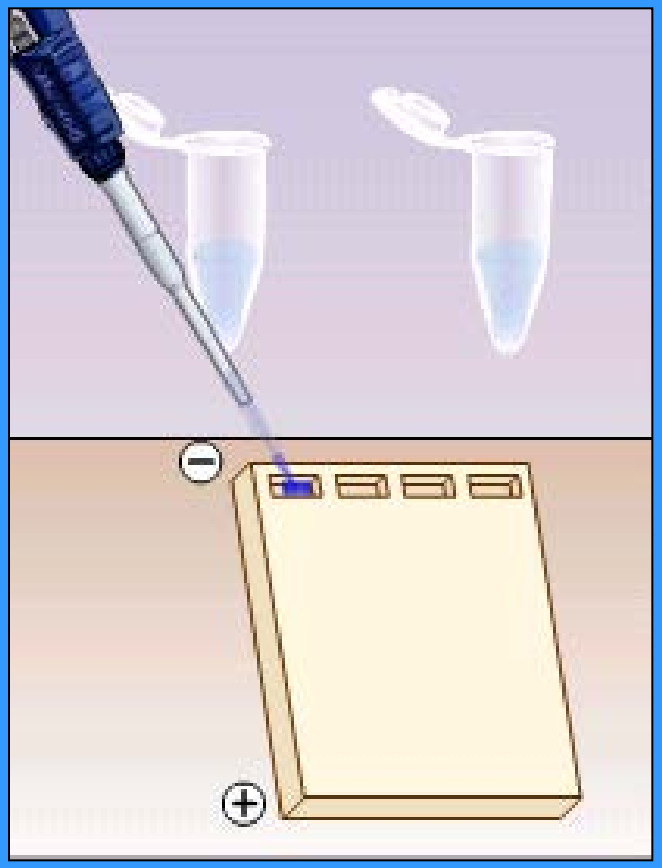
The How-to of Gel Electrophoresis



1st Get the DNA out of the cell.

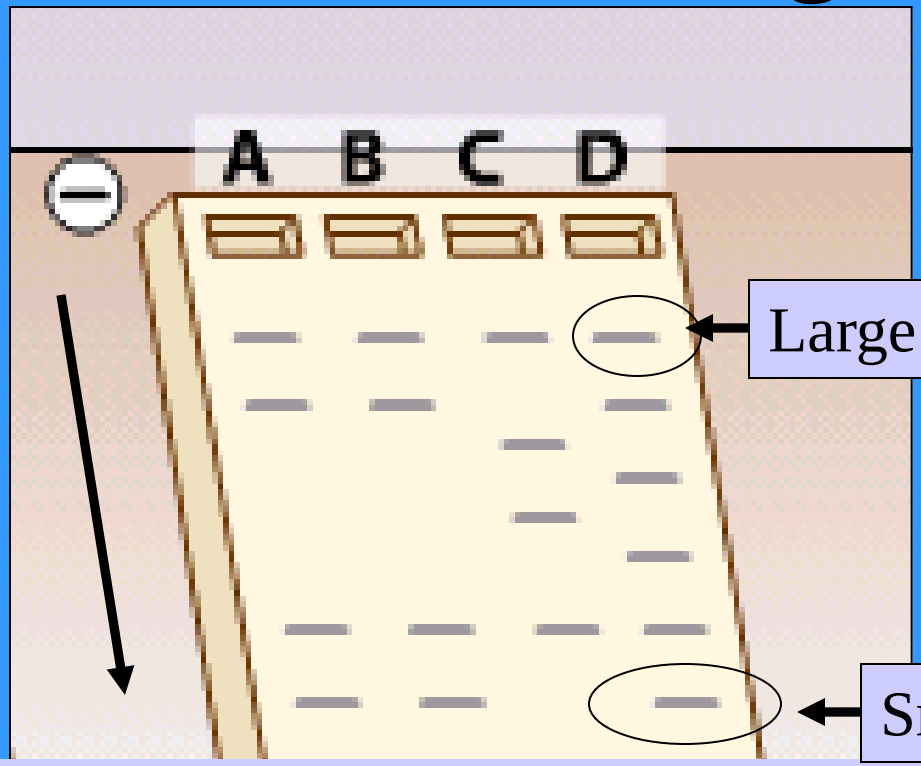
2nd Cut the DNA into pieces using special enzymes called restriction enzymes

Loading DNA



3rd You load the cut DNA into a well of the electrophoresis gel.

Running the gel



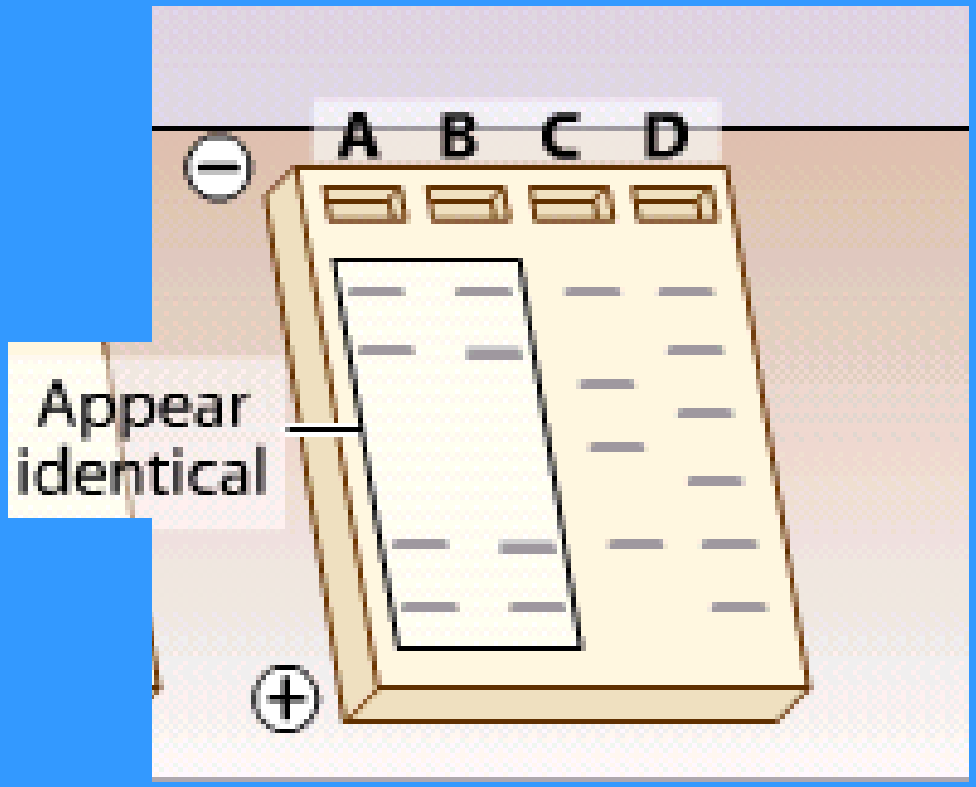
Large Fragment

Small Fragment

The smaller fragments travel further than the large fragments which lag behind.

Positive electrical charge pulls DNA through the gel toward this end

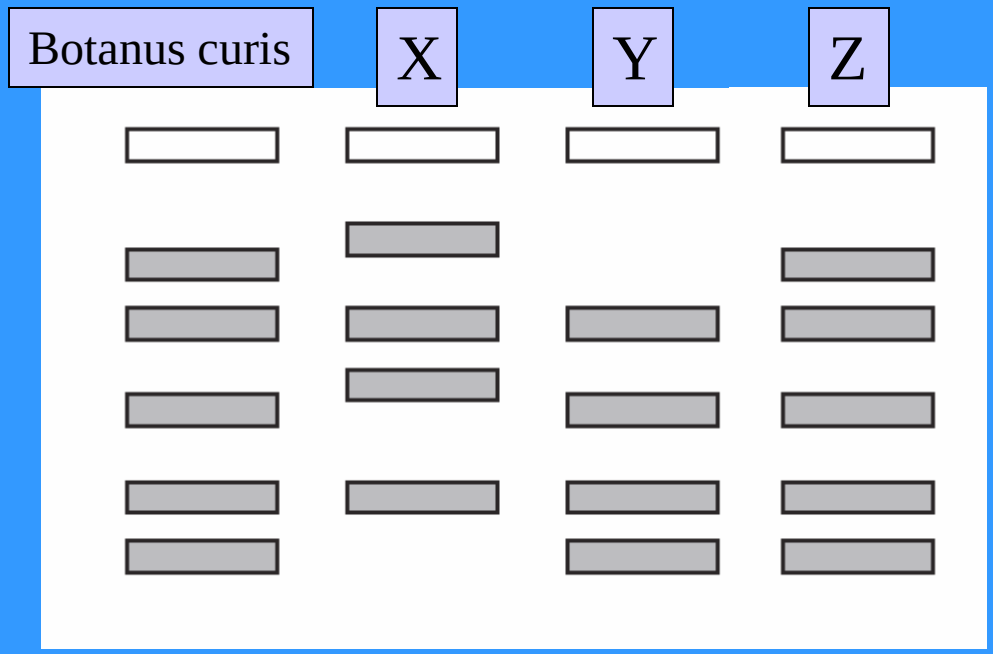
Examining the gel



If you compare samples of cut DNA to each other you can see how closely related each organism is.

The more similarities in fragment sizes the closer in relation the organisms are.

Our Electrophoresis Gel



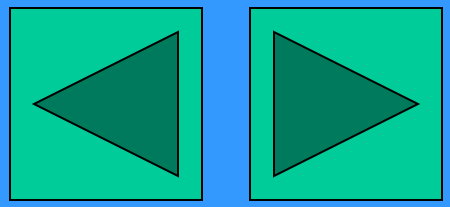
Record how close the gel banding patterns are to *Botana curis*.

Indicate whether the bands are exactly the same, mostly the same or mostly different, in Table 1

Molecular Evidence

Under each DNA sequence in your answer packet, write the complimentary messenger RNA base sequence. Note: Unlike during DNA replication, in the production of messenger RNA, the DNA base “A” specifies the RNA base “U”.

Write the complimentary sequence in your answer packet.



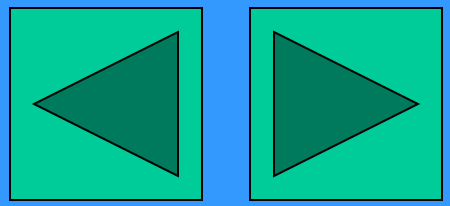
Amino Acid Codes

There is a universal genetic code. Each group of three mRNA bases is called a codon.

Each codon corresponds to an amino acid.

Putting amino acids together in a chain is called protein synthesis.

There is a table in your answer packet that list all of the amino acid codes, write the correct amino acid below its corresponding codon.



Then list how many differences each amino acid sequence has compared to Botana curis. In other words are there one, two or three differences.

Now complete the Analysis of Results section of your packet.

Then answer questions on the reading passage:

The Biodiversity Crisis.