Teacher Guide for Creating Transgenic Corn

For each pair of students:

One lab instruction sheet

yellow highlighter

blue highlighter

one pair of scissors

one pencil

scotch tape

White DNA strip

Pink DNA strip

Have extra DNA strips of each color to allow for mistakes.

Sources Used:

Primrose, S.B. and Twyman, R.M. Principles of Gene Manipulation and Genomics, 7th Edition. Balckwell Publishing, 2006.

http://parts.mit.edu/igem07/index.php/Wet_to_Dry (used slide 16 from Powerpoint for information)

Transgenic Corn

This activity has been modified from a resource developed by the University of Florida:

https://www.cpet.ufl.edu/resources/curricula/bestpractices/bis1/

The original worksheet can be found here: https://www.cpet.ufl.edu/wp-content/uploads/2013/03/Creating-Transgenic-Corn-Lab-Activity.pdf

This activity is to help students understand how science is currently being used to help develop new varieties of species with small changes to the genetic code.

Transgenic means having genetic material from one species incorporated into another. Many scientists are looking at how Transgenic organisms can assist in reducing the occurrence of pest and diseases.

In a species like corn, which is an essential food source around the world, pest and diseases often affect them. To help combat these problems scientists have tried to breed stronger varieties through a process of selection. This selection process has now involved looking closely at corn genes, and those of other species that may be able to help in the defense of pest and diseases.

Scientists have learnt how to isolate certain genes and use the benefits of those genes in other species.

In this activity you are going to use genes from a naturally occurring bacteria called Agrobacterium sp. strain CP4, which has a naturally occurring gene encoding a glyphosate-tolerant enzyme. The glyphosate tolerant enzyme will be inserted into the corn, so that the corn can have the same tolerance to the glyphosate. Glyphosate is the main ingredient in a weed killer to kill weeds.

Weeds in a corn are a problem because they compete for nutrients that the corn farmer wants to be able to grow healthy corn plants.

Why do you think corn with glyphosate tolerance would be good?

How to insert glyphosate tolerant genes into a corn plant:

Step 1

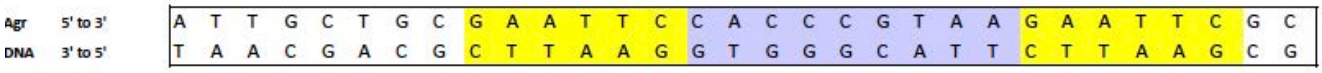
Remove the identified gene from Agrobacterium which has glyphosate tolerance. In this example this is a smaller version of the gene. To cut out the gene, we need to use what is called a ‘restriction enzyme’. The ‘restriction enzyme’ isolates a gene sequence that includes the glyphosate tolerant genes and a couple of extra in the sequence to ensure ‘sticky ends’ (see gene splicing activity for explanation about 'sticky ends'). The restriction enzyme includes this sequence GAATTC

Step 2

On the white strip of DNA (Agrobacterium DNA) using a yellow highlighter, only highlight the sequence GAATTC on the 5’ to 3’ section and the same sequence that runs below on the 3’ to 5’ strand CTTAAG. You should identify two of each sequences.

Agr	5' to 3'	A	T	T	G	C	T	G	C	G	A	A	T	T	C	C	A	C	C	C	G	T	A	A	G	A	A	T	T	C	G	C
DNA	3' to 5'	T	A	A	C	G	A	C	G	C	T	T	A	A	G	G	T	G	G	G	C	A	T	T	C	T	T	A	A	G	C	G

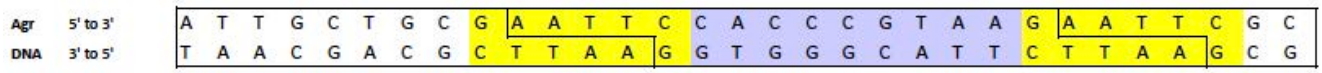
Using a blue highlighter, highlight between the yellow highlighted sections. It should look something like this:



The blue highlighted section is the gene that represents the glyphosate tolerance

Step 3

With a pencil draw lines that cut the GAATTC between the G and A on each sequence. These lines represent the 'sticky ends'. It should look like this:



Step 4

Using scissors cut out the section between the pencil marks. This cut out section is part of the gene that codes for glyphosate tolerance

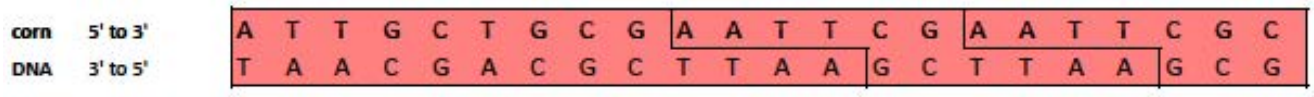
Step 5

The gene selection above now needs to be put into the corn plant so that it can have glyphosate tolerance.

The DNA on the pink strip of paper represents the corn plant. We need to isolate the same gene sequence as above for the Agrobacterium, using the restriction enzyme. The enzyme will isolate the sequence GAATTC.

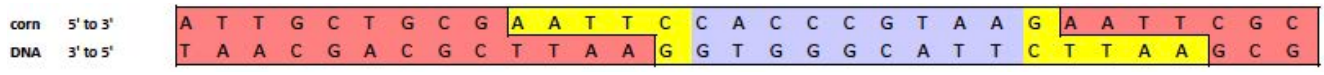
Step 6

With a pencil draw lines that cut the GAATTC between the G and A. You will find two sequences. Once your have drawn the lines, cut out the section.

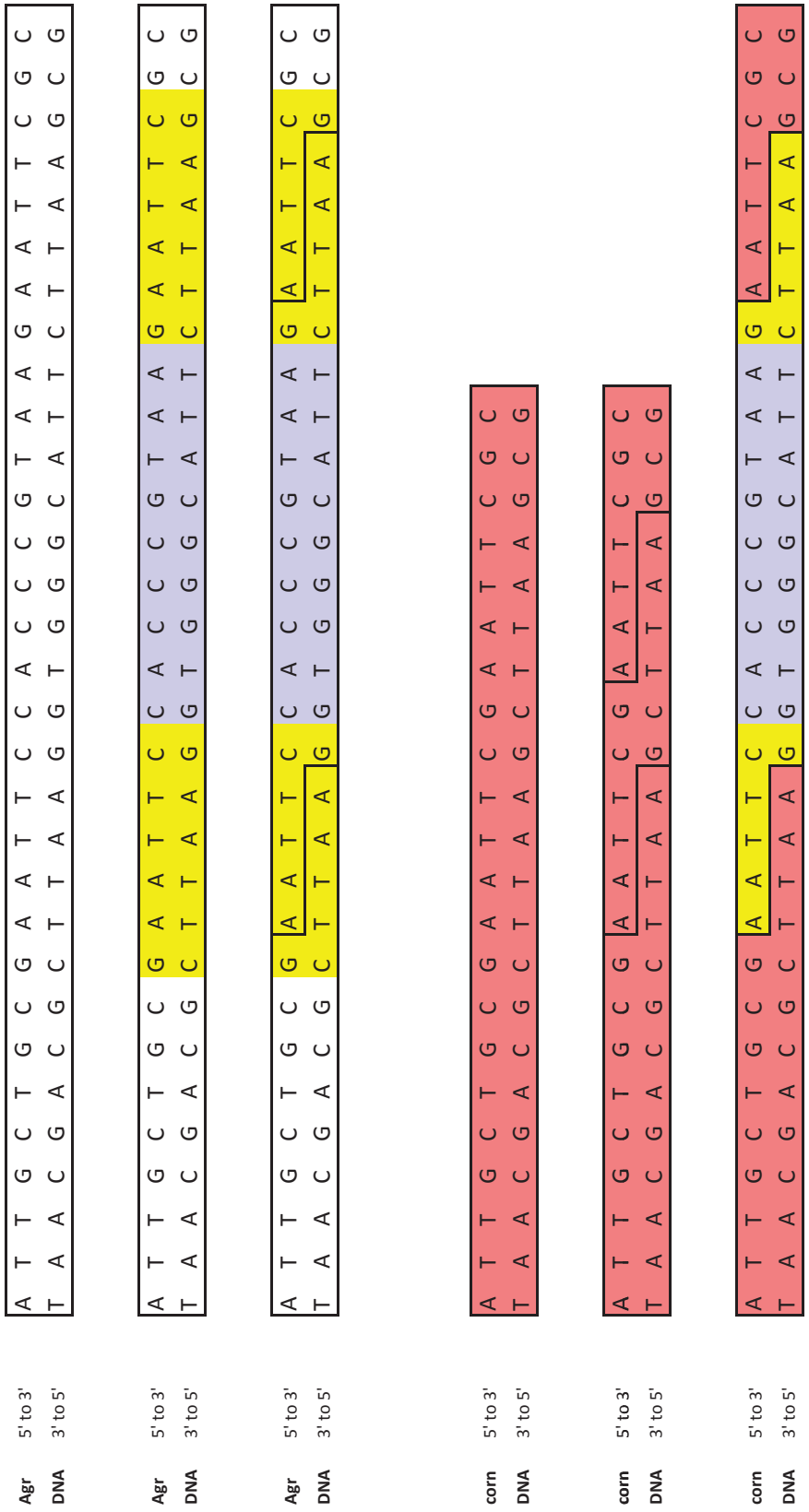


Step 7

The final step is to insert the glyphosate tolerant sequence into the corn plant. In science this would be done with another enzyme, however in this example we will use sticky tape to insert the glyphosate tolerance to the corn. You have now created transgenic corn. Paste your new transgenic corn below:



Breeding a sustainable future



Breeding a sustainable future

Copy this onto white paper

Agr	5' to 3'	A T T G C T G C G A A T T C C A C C C G T A A G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G G T G G G C A T T C T T A A G C G
Agr	5' to 3'	A T T G C T G C G A A T T C C A C C C G T A A G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G G T G G G C A T T C T T A A G C G
Agr	5' to 3'	A T T G C T G C G A A T T C C A C C C G T A A G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G G T G G G C A T T C T T A A G C G
Agr	5' to 3'	A T T G C T G C G A A T T C C A C C C G T A A G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G G T G G G C A T T C T T A A G C G
Agr	5' to 3'	A T T G C T G C G A A T T C C A C C C G T A A G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G G T G G G C A T T C T T A A G C G
Agr	5' to 3'	A T T G C T G C G A A T T C C A C C C G T A A G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G G T G G G C A T T C T T A A G C G
Agr	5' to 3'	A T T G C T G C G A A T T C C A C C C G T A A G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G G T G G G C A T T C T T A A G C G

Breeding a sustainable future

Copy this onto pink paper

corn	5' to 3'	A T T G C T G C G A A T T C G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G C T T A A G C G

corn	5' to 3'	A T T G C T G C G A A T T C G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G C T T A A G C G

corn	5' to 3'	A T T G C T G C G A A T T C G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G C T T A A G C G

corn	5' to 3'	A T T G C T G C G A A T T C G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G C T T A A G C G

corn	5' to 3'	A T T G C T G C G A A T T C G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G C T T A A G C G

corn	5' to 3'	A T T G C T G C G A A T T C G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G C T T A A G C G

corn	5' to 3'	A T T G C T G C G A A T T C G A A T T C G C
DNA	3' to 5'	T A A C G A C G C T T A A G C T T A A G C G