Practical Knowledge of Plants

Why is Vitamin C important?

Vitamin C – citrus fruits, green leafy vegetables

- Important in the production of collagen.
- Collagen helps in the development of gums, blood vessels and bones.
- Helps in the absorption of iron.
- Decreases blood pressure (relaxes blood vessels)
- Lack of vitamin C can lead to a condition called **scurvy**, which causes muscle weakness, swollen and bleeding gums, loss of teeth, and bleeding under the skin, as well as tiredness and depression.

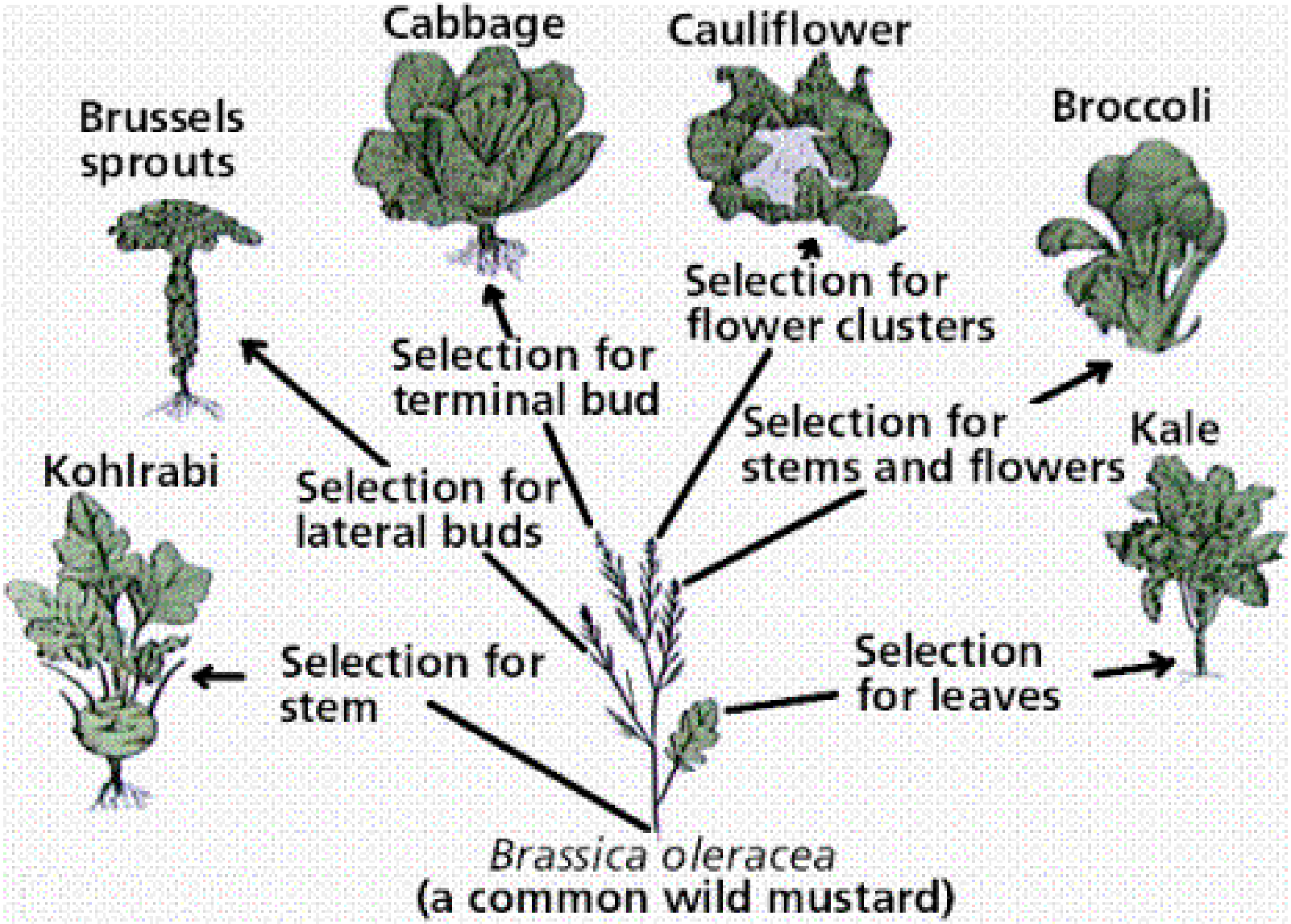
Plant Technologies

- Artificial Selection – The **desired traits** of a plant are selected.

Cabbage, broccoli, cauliflower, Brussels sprouts, collards and kale are have all originated from the same wild mustard plant.

Plant Technologies

- Artificial Selection



Why select for certain traits?

-Help people around the world gain more nutrients through carbohydrate rich plants.

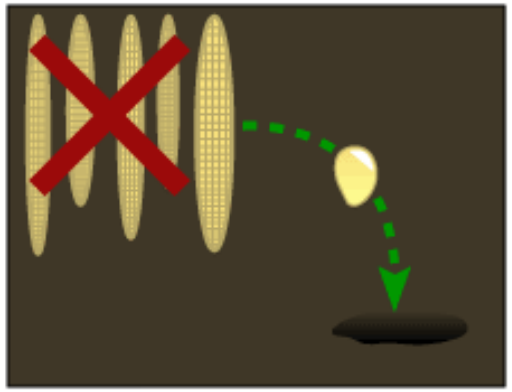
-Top three carbohydrate crops are:

Rice, Corn and Cassava

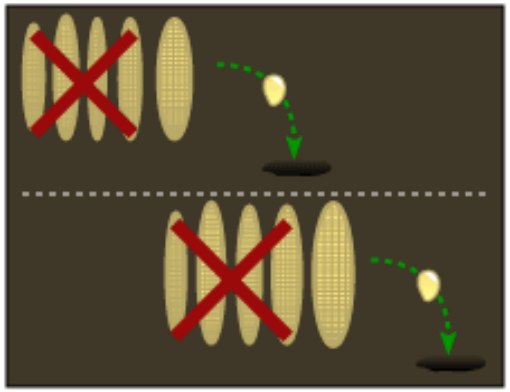
Why select for certain traits?

- Improving the yield (how much is produced) and quality of the crops can help nourish areas in the world where there is currently a lack of food.

1. Natural variation occurs in the wild population.



2. Seeds for the next generation are chosen only from individuals with the most desirable traits.

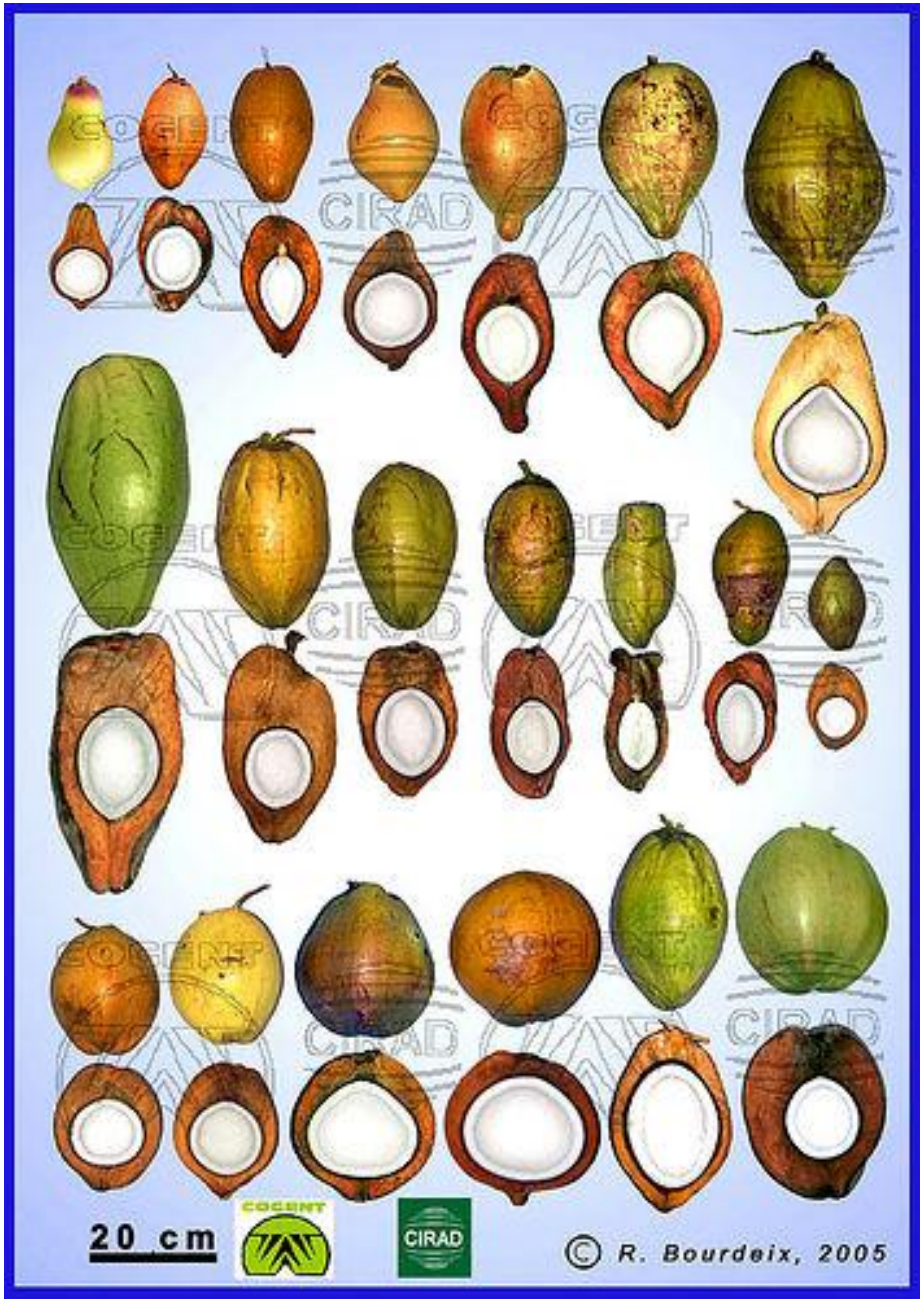


3. Repeat this process for several generations.

4. Over time, the quality of the crop increases.

Mass Selection

- Gathering the seeds of the biggest and strongest plants.
- These seeds would then be planted the following season and farmers would get big and strong plants.
- When this is repeated over many generations the result is more cereal crops (corn, rice and wheat)



Pure Line Selection

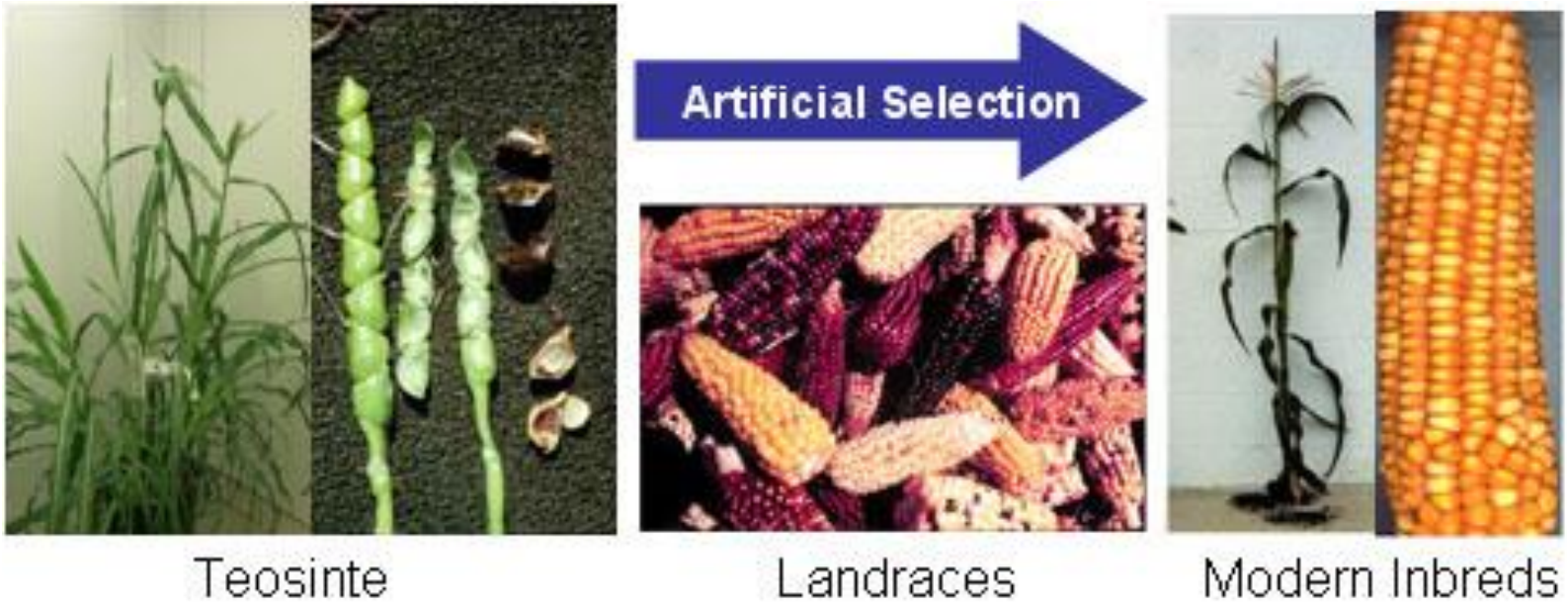
- Mating plants with certain desired traits.
- Only offspring that express desired trait are allowed to reproduce.
- Offspring are mated for several generations until every generation has desired trait.
- Example: wheat (pure line selection to improve winter hardiness, rust resistance, and earliness in maturity)

Cross Breeding

- Combining two or more desirable features in ONE offspring.
- Example: Farmers wanted the tomato firm and square in shape.

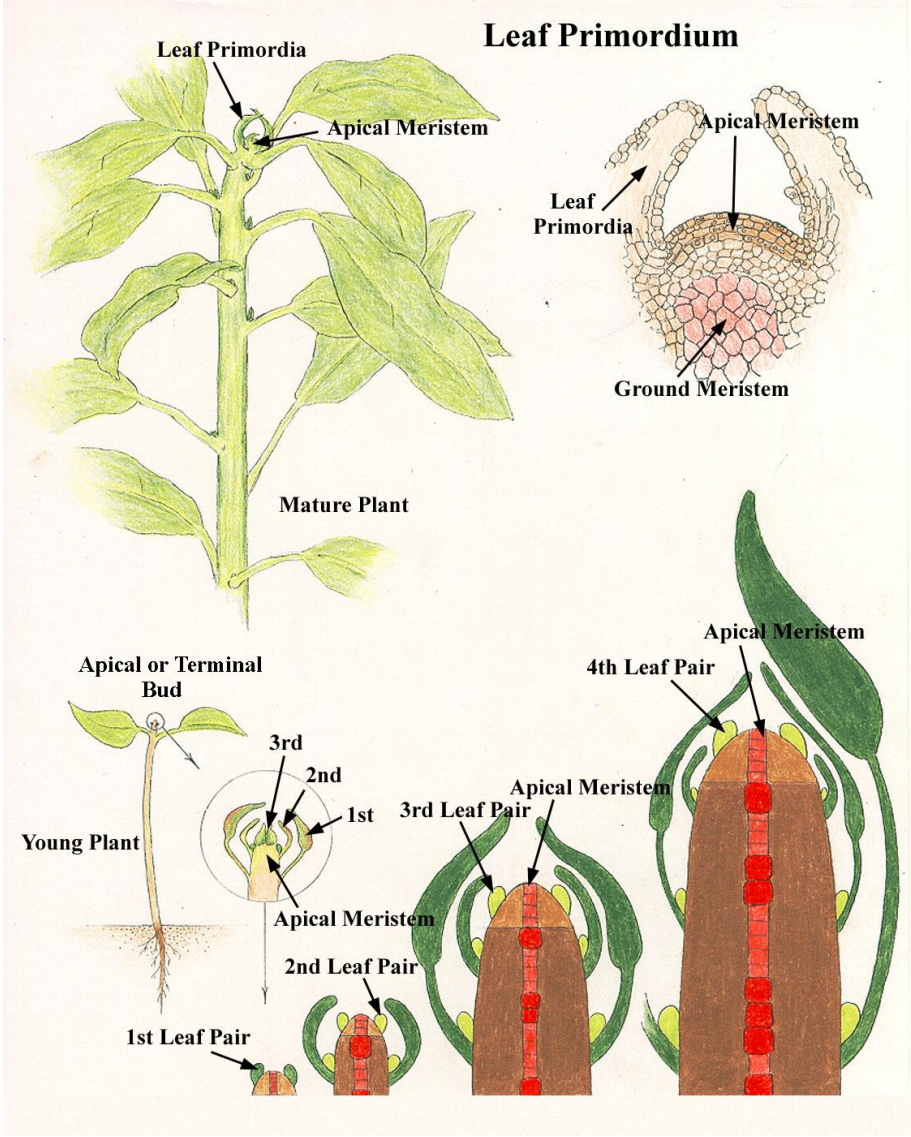
Benefits of Artificial Selection

- Keep in mind that people have been doing this for thousands of years.
- Works on any plant that produces seeds.
- Can select for any trait that you feel is desirable.
- Disadvantage: Takes a long time and many trials before you get the results you are looking for.



Tissue Culturing Technology

- Obtain cells from MERISTEM cells of a plant.
- Grow cells in a culture through the process of mitosis. The mass of cells is now called a CALLUS.
- Add hormones such as AUXIN and CYTOKININ so that roots and shoots grow.
- http://www.youtube.com/watch?v=TooMSbuZR6c

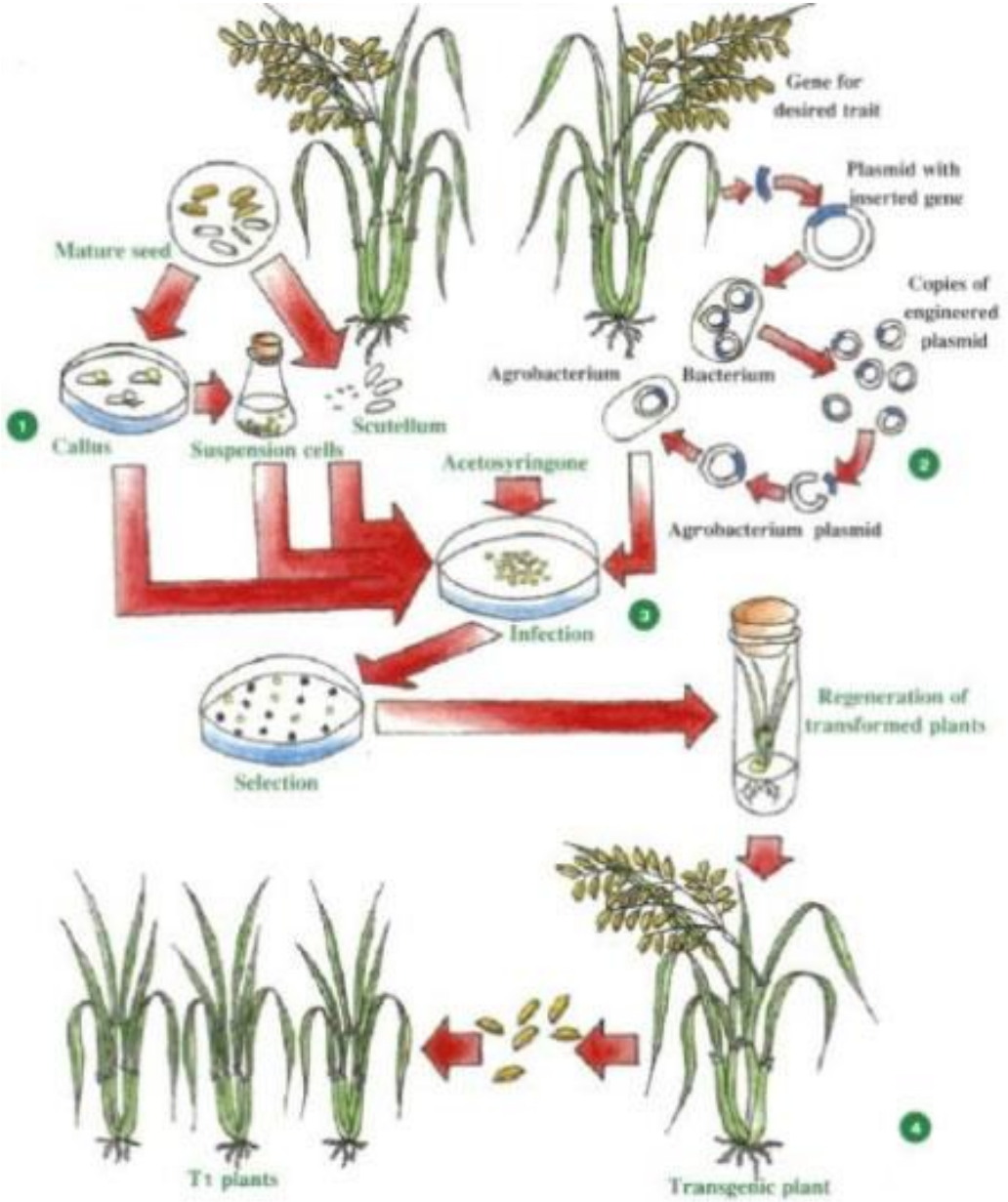


Gene Transfer Technology

A faster way of getting the desired trait by getting into the DNA of the organism.

People don't have to rely on the crossbreeding methods that can take years to get the desired trait.

http://www.youtube.com/watch?v=L7qnY_GqytM



How is gene transfer possible?

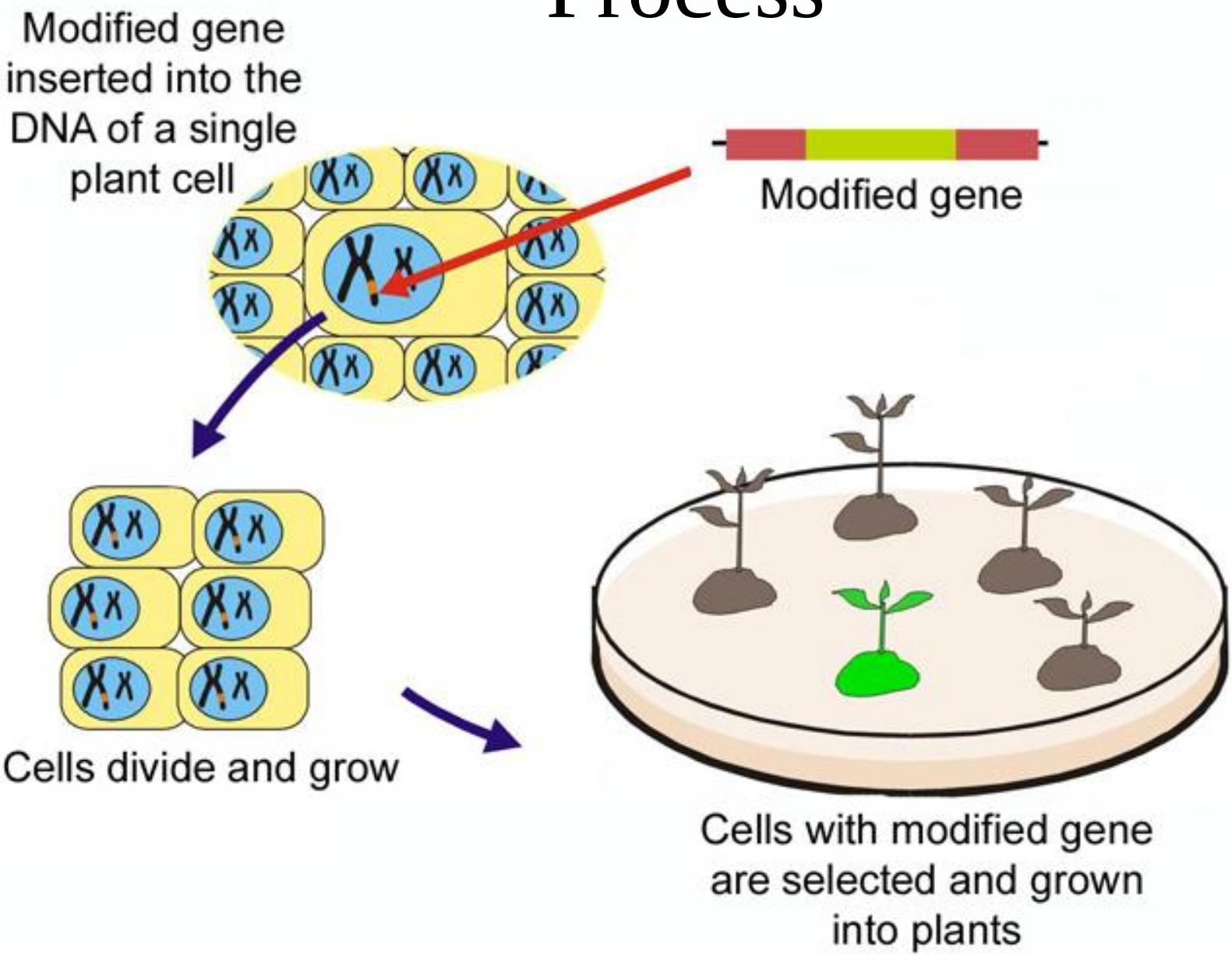
- All living things are run by instructions coded by DNA.
- Cell structures and cell organelles are similar in all kingdoms. Therefore, genes can be snipped out of one species (the host) and spliced into the genome of another (the recipient).
- Example: tomato crops can withstand frost because a gene taken from a fish (the winter flounder, which can live in cold environments) was placed into the tomato's genome.

Normal parent Hybrid offspring

Process

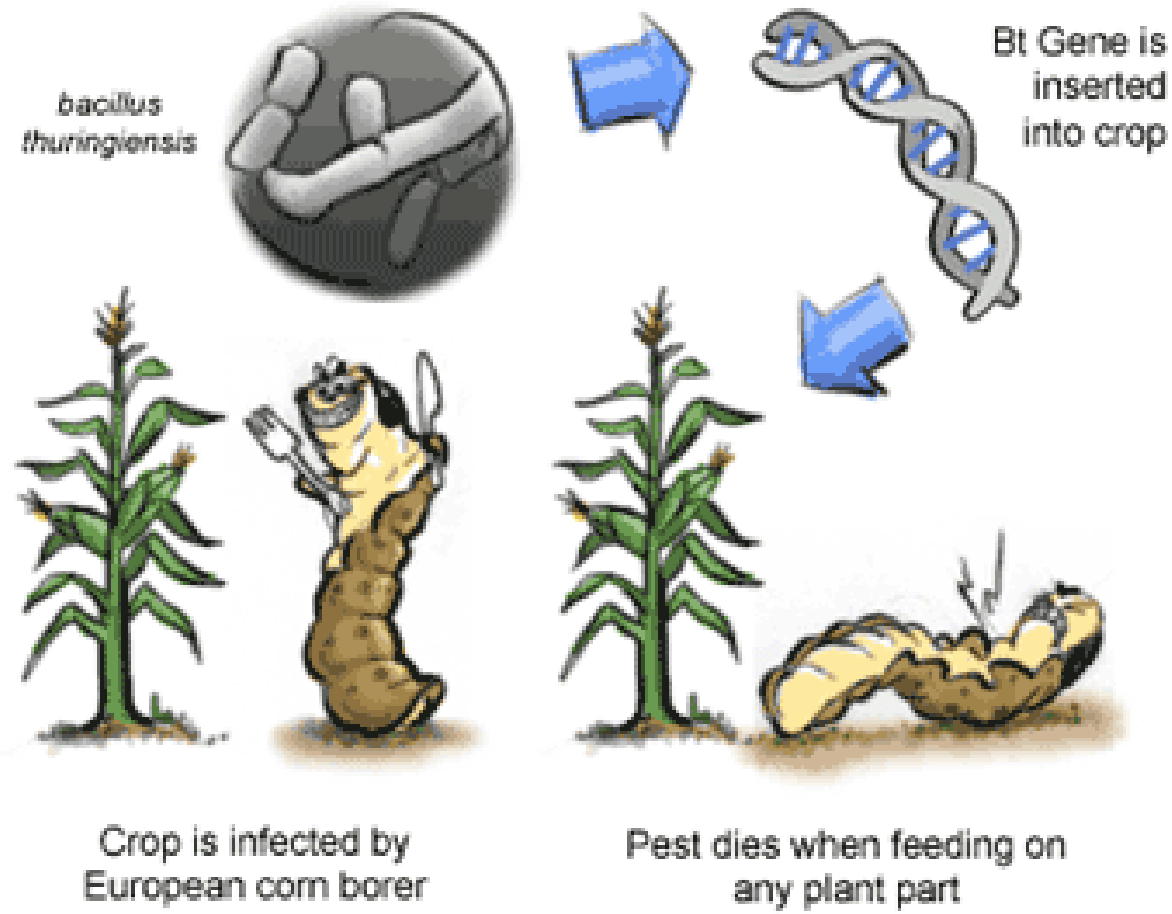
1. The target gene is identified (can take years).
2. Target gene is isolated from nuclei of the host.
3. Multiple copies of the targeted gene are made and suspended in a liquid.
4. Recipient plant cells (cells walls removed) are added to the liquid that contain all the targeted genes.
5. An electric current opens tiny, temporary holes in the cell membranes. The target gene enters the cell.
6. The cells are collected and tested to see if they contain the targeted gene. Hormones are applied to increase the rate at which the plants grow.
7. Resulting plants have the spliced gene in every nucleus.

Process


Modified gene inserted into the DNA of a single plant cell
Modified gene
Cells divide and grow
Cells with modified gene are selected and grown into plants

Bt gene

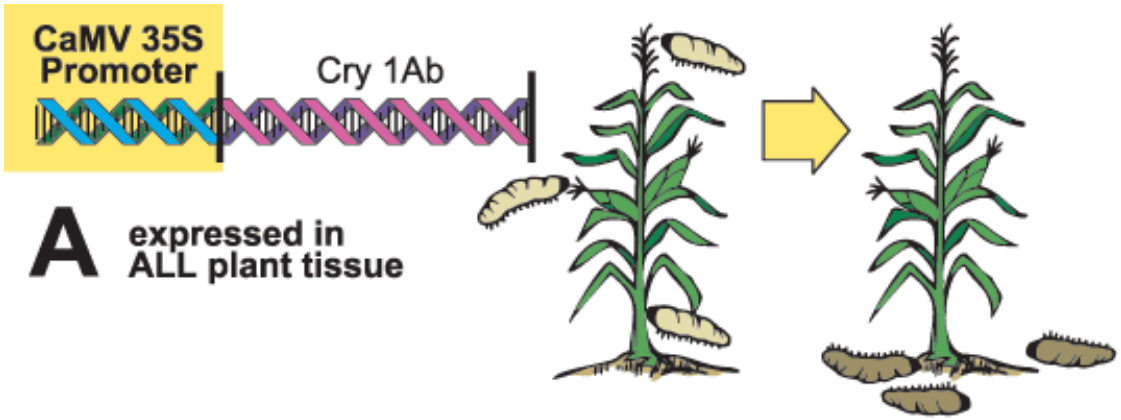
- Bacillus thuringiensis is a bacteria found in soil.
- It produces a protein that paralyzes the insects digestive system. The insect dies of starvation.
- The gene that is responsible for coding for the protein that kills insects is inserted into the DNA of many plants such as corn and cotton.
- The plant then produces the protein that is responsible for killing insects (its own personal insecticide)



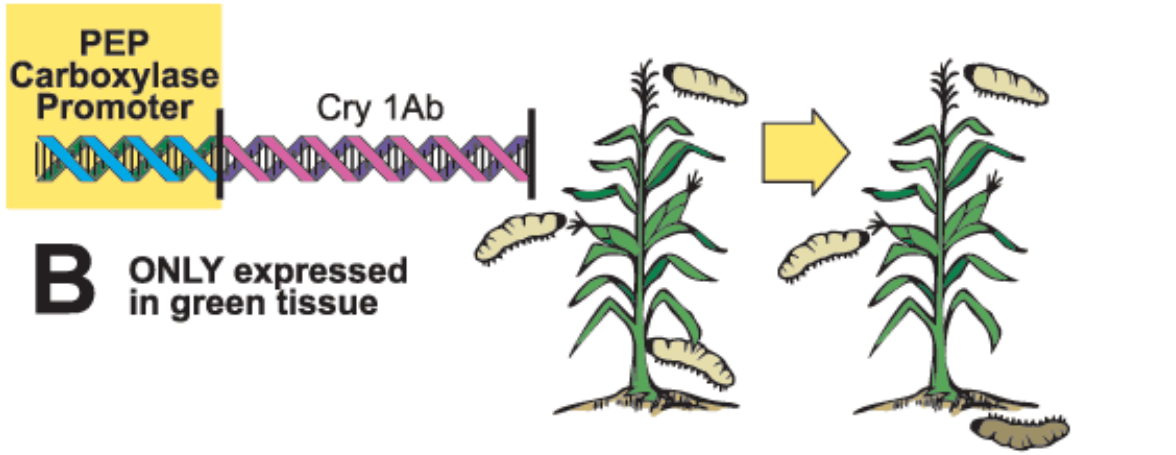
Advantages of Bt gene

-Bt does not kill beneficial organisms; it only kills insects that harm the plant

-farmers reduce the spraying of pesticides.



European corn borer feeding any plant part die when the *Bt* is expressed in all tissues.



When *Bt* is expressed only in green tissue,those European corn borer feeding on tassel and ear do not die.

Effectiveness depends on where the gene is inserted

Disadvantages of Bt gene

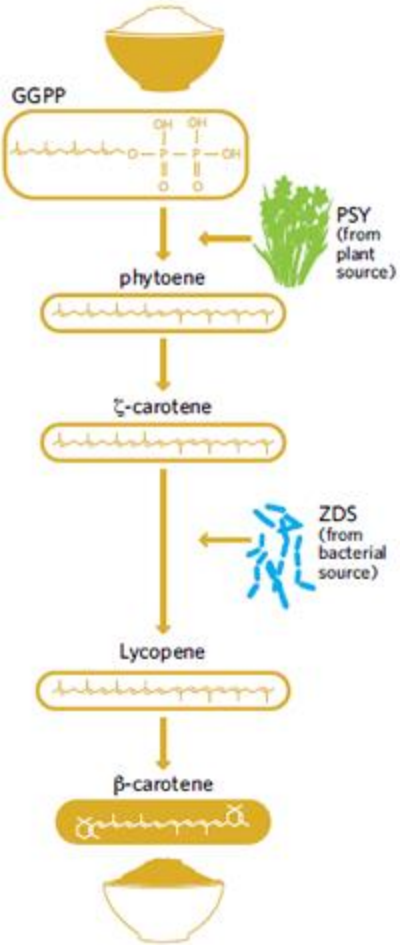
- Cross-contamination of gene – Pass the gene to native species (not yet proven).
- Resistance to Bt proteins by insects.
- http://www.youtube.com/watch?v=L7qnY_GqytM

Golden Rice

- In *Golden Rice* two genes have been inserted into the rice genome by genetic engineering. This leads to the production and accumulation of β-carotene in the grains.
- http://www.youtube.com/watch?v=0-SkjNgUMHc

Golden Rice

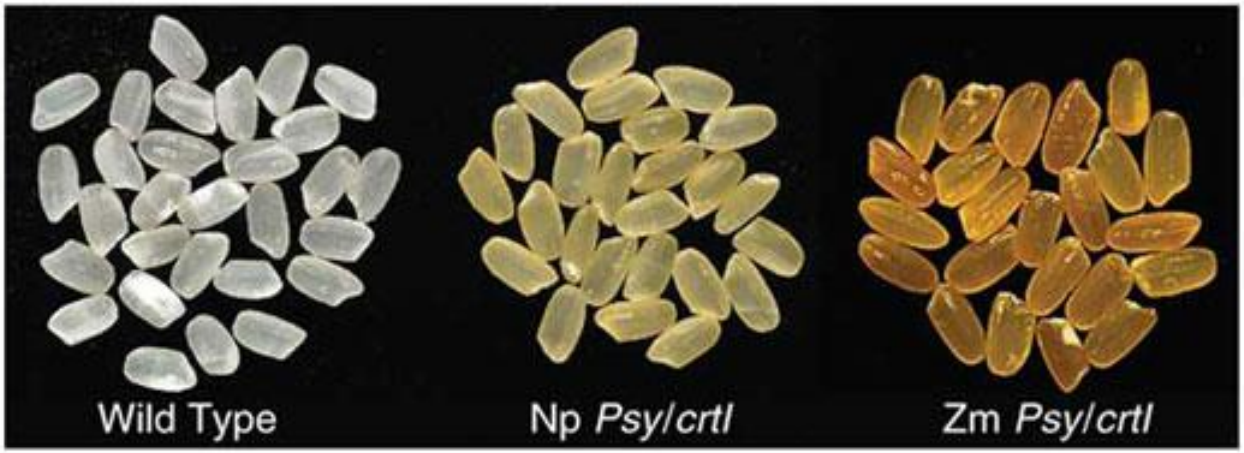
- According to the World Health Organization, dietary vitamin A deficiency (VAD) causes some 250,000 to 500,000 children to go blind each year. Blindness and corneal afflictions are but indicators of more severe underlying health problems: more than half the children who lose their sight die within a year of becoming blind.



Due to market concerns, California rice growers are cautious about adopting transgenic crops that could cross with conventional varieties. *Left*, U.S. long-grain rice and, *top right*, rice grains. *Lower right*, "golden rice" is genetically engineered to accumulate pro-vitamin A in the grain, in order to help fight nutritional deficiency diseases in developing countries.

Interesting!

Golden Rice grains are easily recognizable by their yellow to orange colour, the stronger the colour the more β-carotene. While a yellow rice is still unfamiliar to most of us, it is hoped that the pleasant colour will help promote its adoption. Would you believe that once upon a time carrots were white or purple? Orange-coloured carrots are the product of a mutation selected by a Dutch horticulturist a few hundred years ago because it was the colour of the Dutch Royal House of Orange-Nassau!

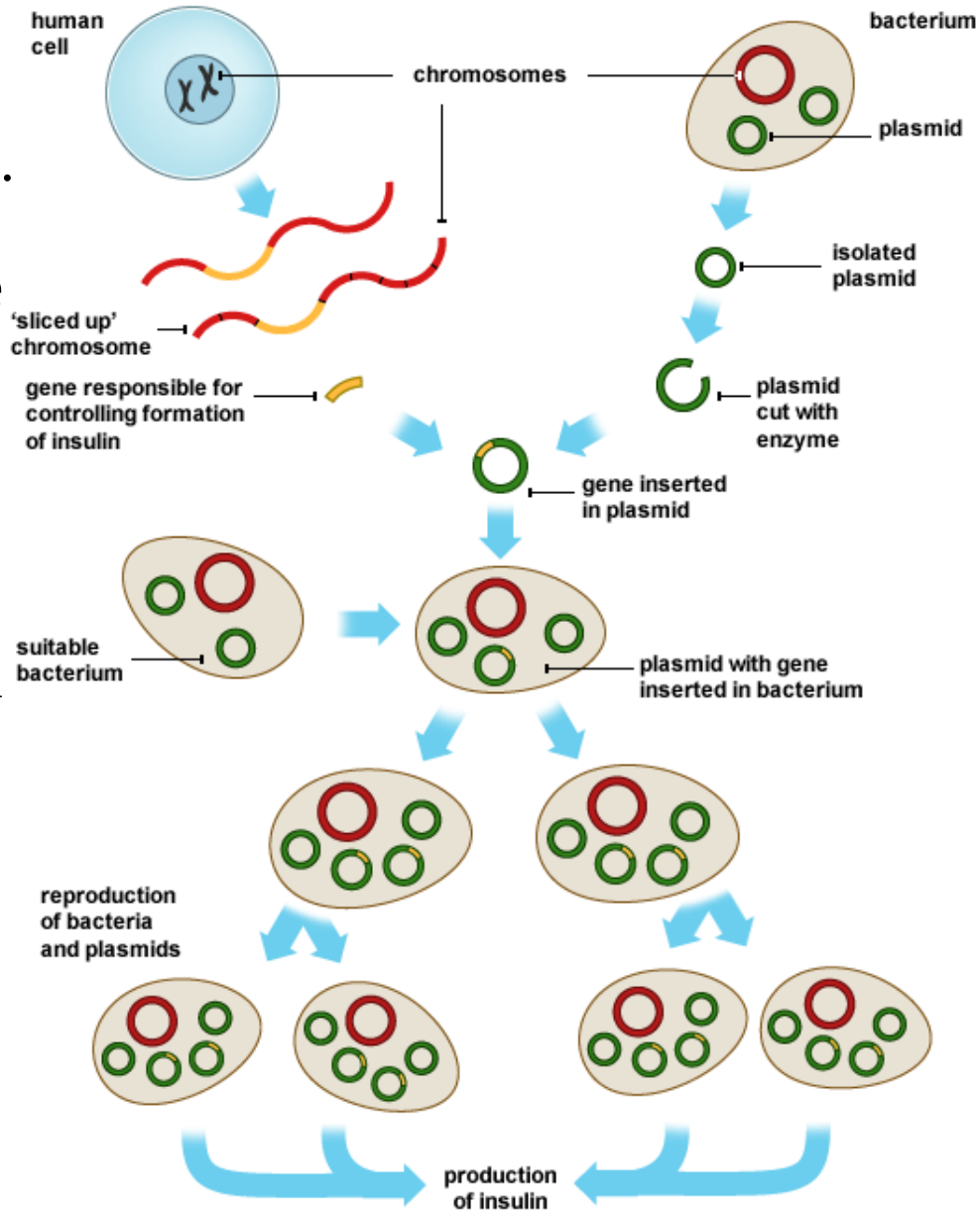


Interesting!

Tomatoes were artificially selected. "Heirloom" tomatoes come in different colours, shapes, and sizes.

Genetic Engineering and Diabetes

- Your body gets energy by making glucose from foods like bread, potatoes, rice, pasta, milk and fruit. To use this glucose, your body needs insulin. Insulin is a hormone that helps your body control the level of glucose (sugar) in your blood.
- Type 1 diabetes is a disease in which the pancreas does not produce insulin. If you have type 1 diabetes, glucose builds up in your blood instead of being used for energy.
- Genetic engineering has enabled bacteria to manufacture large quantities of insulin for our use



- http://www.youtube.com/watch?v=AEINuCL-5wc&NR=1

Edible Measles Vaccine

- Although measles can be effectively prevented by a 'live' measles vaccine injection, it still causes up to one million deaths each year, mostly among young children in developing countries.
- In these countries, injectable vaccines are inhibited by many factors, including the need to provide a stable and cold environment during storage and transportation and a lack of trained medical staff to administer the vaccine.