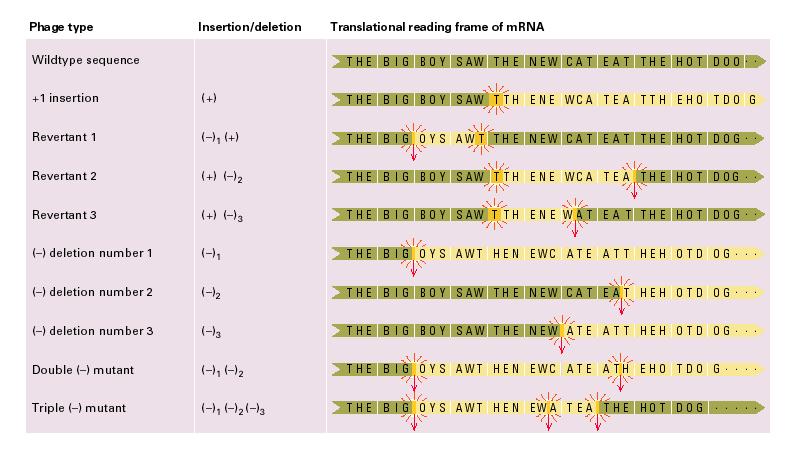
Errors=mutations

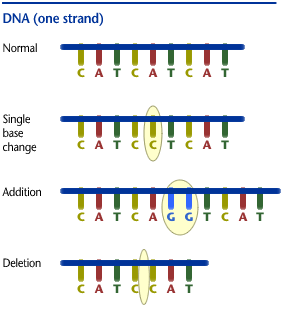
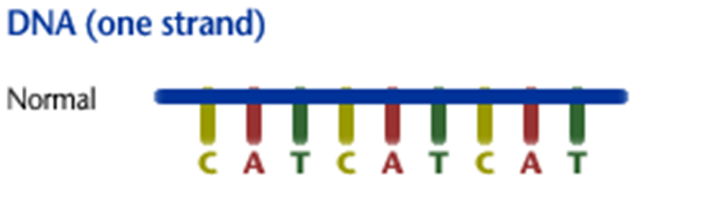
1. Mutations can occur \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or through \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ factors.
   1. Environmental \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ include some \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (food additives, pesticides, plastics) and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (xrays to UV light)
2. A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a change of one or more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a single gene. There are three types
   1. Addition
   2. Deletion
   3. Substitution

GENE MUTATIONS

1. Deletion: one nucleotide base is left out. All of the amino acids after a deletion will be wrong, so \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of protein are altered. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



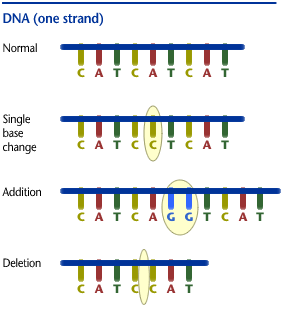
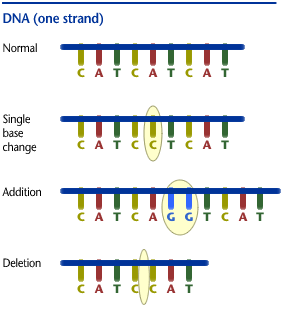
1. Addition: One extra nucleotide base is added. This will also change the entire amino acid sequence of the protein so \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of protein are altered. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



1. Substitution: When single bases or short pieces are replaced with one another.

Example: Sickle-Cell Anemia, only one nucleotide base is switched. This causes only 1 amino acid to change, but it an important one.

This type of mutation is usually \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as the 1st two. It just depends on which amino acid is affected; as several nucleotide sequences may code for same amino acid.



1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mutations: a mutation of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a chromosome. These affect \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
   1. Example 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ where one part of a chromosome changes places with another. This can cause extra pieces, missing pieces, or the exchange of pieces of chromosomes. Examples: Cri du Chat \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Example 2;\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ extra chromosomes or missing chromosomes due to mistakes during mitosis or meiosis (cell division)

Examples: Down Syndrome \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, Klinefelter Syndrome\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, Turner’s Syndrome \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Current Technology and News**

Recombinant DNA

Definition: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Gene \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-: add an extra copy of gene (cows with huge teats to make double the mile) or deleting genes (removing the rotting hormone from tomatoes)
2. Gene \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: repairing a gene (as in gene therapy)
3. Gene \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: inserting genes from a different species to give a new function (as in making goats with spider proteins in their milk or making bacteria that create human insulin).

Transgenic Organism-Organisms who have the DNA of other organisms inserted in them, recombining their DNA.

What is a GMO?

-result of technology that has altered the DNA of living organisms (animals, plants or bacteria)

-other terms that mean the same thing

-genetically engineered, transgenic, Recombinant DNA (rDNA technology.

GM vs. Selective breading

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-slow

-imprecise

-modification of genes that naturally occur in the organism

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-very fast

-precise

-can introduce genes into an organism that would not occur naturally!

Why do it?

* Rice- not high in essential nutrients
  + Modification:
* + daffodil genes and a bacterium = beta-carotene content drastically increased
* + genes from a french bean = double the iron content.
* Tomatoes- Introduce genes to increase shelf life.
* Other Applications
* Potato - modified to produce a beetle killing toxin
* Yellow squash – modified to contain to viral genes that resistant the most common viral diseases
* Develop foods that contain vaccines and antibodies that offer valuable protection against diseases such as cholera, hepatitis, and malaria
* Canola – modified to resist one type of herbicide or pesticide

**Benefits of Genetic Engineering   
and Modifying**

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ crops, more efficient use of land
* Can save money and promote higher profits
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ shelf life, less waste
* Example/ Tomatoes from genetically modified seeds stay fresh longer.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ taste and quality
* Reduced maturation time

**Benefits of Genetic Engineering and Modifying Genes**

1. Increased and improved nutrients and stress tolerance
   1. A single gene genetically engineered into cauliflower can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of beta-carotene 100 times.
   2. A gene can be implanted into a soybean upgrading the soy protein to a quality equal to that of milk.
   3. Corn can be modified to contain its two limiting amino acids, lysine or tryptophan
2. Improved \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or illness
   1. Foods can be enhanced with phytochemicals that help maintain health and reduce the risks of chronic disease.
3. Improved crop resistance to disease, pests, weeds and herbicides
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and growing techniques
   1. “Individuals allergic to milk may be able to buy milk that has been treated with the lactase enzyme

Creating decaffeinated coffee beans are in a process of research.

Who Uses this technology? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Risks associated with Genetic Modification**

**1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* Potential human health implications.
* Cancer, liver, kidney damage in studies with rats
* Potential environmental impact.
* **Out-crossing**
* Inevitable out-crossing of transgenic plants with naturally occurring ones.
* Creation of super-weeds
* Creation of biological weapons.

**2. Access and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* Domination of world food production by a few companies and developing countries.

**3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* “Playing God”
* Tampering with nature by mixing genes

among species.

**4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* Not mandatory in some countries (e.g., Canada and the United States).
* Mixing GM crops with non-GM confounds labeling attempts.

**5. Society**

* New advances may be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the interests of rich countries.

(Human Genome Project Information (2003), http://www.ornl.gov/sci/techresources/Human\_Genome/elsi/gmfood.shtml