4. 10: Mutation Effects

Is this rat hairless?

Yes. Why? The result of a mutation, a change in the DNA sequence. The effects of mutations can vary widely, from being beneficial, to having no effect, to having lethal consequences, and every possibility in between.
Effects of Mutations

The majority of mutations have neither negative nor positive effects on the organism in which they occur. These mutations are called neutral mutations. Examples include silent point mutations. They are neutral because they do not change the amino acids in the proteins they encode.

Many other mutations have no effect on the organism because they are repaired before protein synthesis occurs. Cells have multiple repair mechanisms to fix mutations in DNA. One way DNA can be repaired is illustrated in Figure below. If a cell’s DNA is permanently damaged and cannot be repaired, the cell is likely to be prevented from dividing.

![DNA Repair Pathway](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_Introductory_Biology_(CK-12)/4%3A_Mol…)

DNA Repair Pathway. This flow chart shows one way that damaged DNA is repaired in *E. coli* bacteria.

Beneficial Mutations

Some mutations have a positive effect on the organism in which they occur. They are called beneficial mutations. They lead to new versions of proteins that help organisms adapt to changes in their environment. Beneficial mutations are essential for evolution to occur. They increase an organism’s changes of surviving or reproducing, so they are likely to become more common over time. There are several well-known examples of beneficial mutations. Here are just two:

1. Mutations in many bacteria that allow them to survive in the presence of antibiotic drugs. The mutations lead to antibiotic-resistant strains of bacteria.
2. A unique mutation is found in people in a small town in Italy. The mutation protects them from developing atherosclerosis, which is the dangerous buildup of fatty materials in blood vessels. The individual in which the mutation first appeared has even been identified.

Harmful Mutations

Imagine making a random change in a complicated machine such as a car engine. The chance that the random change would improve the functioning of the car is very small. The change is far more likely to result in a car that does not run.
well or perhaps does not run at all. By the same token, any random change in a gene's DNA is likely to result in a protein that does not function normally or may not function at all. Such mutations are likely to be harmful. Harmful mutations may cause genetic disorders or cancer.

- A **genetic disorder** is a disease caused by a mutation in one or a few genes. A human example is cystic fibrosis. A mutation in a single gene causes the body to produce thick, sticky mucus that clogs the lungs and blocks ducts in digestive organs. You can watch a video about cystic fibrosis and other genetic disorders at this link: [http://www.youtube.com/watch?v=8s4he3wLgkM](http://www.youtube.com/watch?v=8s4he3wLgkM) (9:31).

- **Cancer** is a disease in which cells grow out of control and form abnormal masses of cells. It is generally caused by mutations in genes that regulate the cell cycle. Because of the mutations, cells with damaged DNA are allowed to divide without limits. Cancer genes can be inherited. You can learn more about hereditary cancer by watching the video at the following link: [http://www.youtube.com/watch?v=LWk5FplsKwM](http://www.youtube.com/watch?v=LWk5FplsKwM) (4:29).

### Albino Redwoods, Ghosts of the Forest

What happens if a plant does not have chlorophyll? They would lack the part of the leaf that makes them green. So these plants could be referred to as albino. This would have to result from a genetic mutation. Do these plants die because they cannot photosynthesize? Not necessarily. What can these plants tell us about the biochemistry, genetics and physiology of plants?


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**Summary**

- Mutations are essential for evolution to occur because they increase genetic variation and the potential for individuals to differ.
- The majority of mutations are neutral in their effects on the organisms in which they occur.
- Beneficial mutations may become more common through natural selection.
Harmful mutations may cause genetic disorders or cancer.

Making Connections

Media, iframe, embed and object tags are not supported inside of a PDF.

Explore More

Explore More I

Use these resources to answer the questions that follow.

- [http://www.hippocampus.org/Biology](http://www.hippocampus.org/Biology) → Non-Majors Biology → Search: Genetic Disorders

1. Define genetic disorders.
2. What are the two primary types of genetic aberrations?
3. What is a carrier?

Explore More II

- [http://www.hippocampus.org/Biology](http://www.hippocampus.org/Biology) → Non-Majors Biology → Search: Gene Defects

1. What are the results of a mutation or defect in a single gene?
2. Describe the causes and effects of cystic fibrosis, Huntington's Disease, and hemophilia.

Explore More III

- [http://www.hippocampus.org/Biology](http://www.hippocampus.org/Biology) → Non-Majors Biology → Search: Chromosomal Abnormalities

1. What is a chromosomal disorder?
2. When and how do chromosomal errors occur?
3. Describe an inversion and translocation.
4. Describe the causes of Cri-du-chat Syndrome and Down Syndrome.

Explore More IV

- Test Neurofibromin Activity in a Cell [at http://learn.genetics.utah.edu/con...neurofibromin/](http://learn.genetics.utah.edu/con...neurofibromin/).
Review

1. Why are mutations essential for evolution to occur?
2. What is a genetic disorder?
3. What is cancer? What usually causes cancer?