Genetics at Work

A Reading A–Z Level Z Leveled Book
Word Count: 1,715

Connections

Writing

Create a pamphlet describing the job opportunities available in the field of genetics. Provide at least five different options with a description of each.

Science

Create a timeline showing major developments in the field of genetics. Research to find additional information to add to your timeline.

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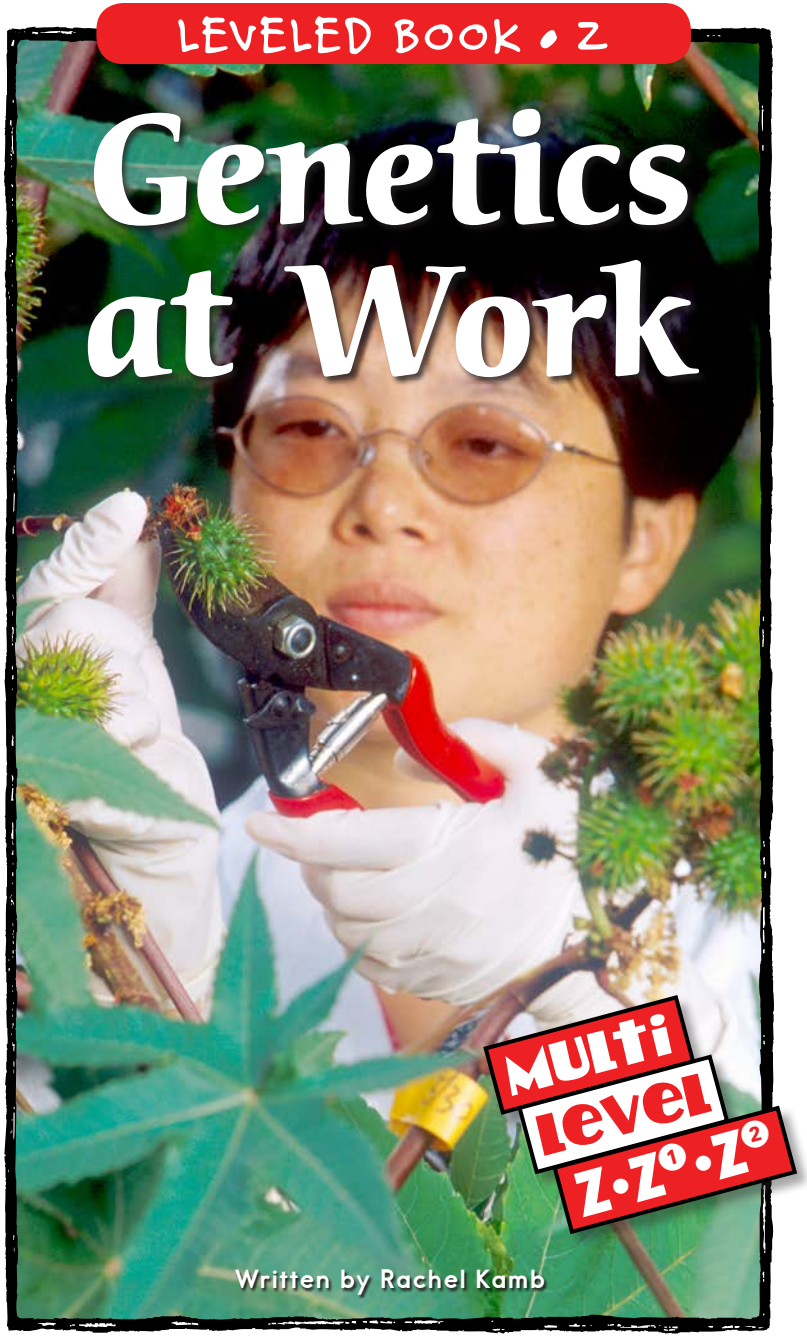

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Written by Rachel Kamb

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Focus Question

How has the science of genetics evolved over time?

Words to Know

captive breeding
characteristics
diversity
DNA
genes
genetics
habitats
hybrid
hybridization
selective breeding
species
traits

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Correlation

LEVEL Z	
Fountas & Pinnell	U–V
Reading Recovery	N/A
DRA	50

Table of Contents

Family members look alike because they share the same inherited traits.

Introduction

Do you sometimes wonder what you want to be when you grow up? Have you ever thought about being a doctor or a detective, or working with animals? All these jobs have one thing in common—**genetics**.

What is genetics? Genetics is the field of science that studies how all living things pass traits from one generation to the next. **Traits** are features such as hair color, finger length, and nose shape.

Understanding genetics is important in many jobs, including farming, breeding animals, curing diseases, preventing potential illnesses, solving crimes, and more.

Farming

Although genetics is a new science, there is evidence of people using genetic techniques to create better crops and animals as early as 5000 BC. **Selective breeding** is one of these techniques. Scientists select plants with traits they like, such as quick-growing or attractive fruit, to breed with other plants that have those same traits. By selectively breeding these plants, scientists ensure that the plants' desirable traits are passed on to create crops that grow faster and produce better fruit.

Think about the many types of tomatoes you can buy at the supermarket. These varieties are the result of the selective breeding of tomato plants. Wheat, soybeans, and corn are other common crops that are grown using genetic techniques. With the help of genetics, farmers will be able to grow plants for us to eat that have higher protein and lower oil and that can grow faster than ever before.

Dozens of varieties of tomatoes have been bred from a single wild variety.

Scientists also use genetic techniques with animals. For example, they use genetic breeding techniques to create chickens that lay more eggs. They create cows that grow faster and produce more milk.

Selectively bred piglets grow up faster than their wild cousins.

Genetics sounds great for farming. Why wouldn't we want crops that grow faster and taste better, and cows that produce more milk? Some say that genetically changing our crops and animals will damage their genetic **diversity**. By only breeding for a select group of traits, many other useful plant and animal traits may be lost forever. The lack of genetic diversity among crops and animals may also leave them vulnerable to a single virus that could wipe out an entire **species**.

People in favor of using genetics in farming want to improve food productivity. Those against it are concerned about the unknown effects it might have on our environment and our health.

Animal Breeding

Animal breeders use some of the same genetic techniques as plant scientists. These include selective breeding and **hybridization**.

Hybridization, or crossbreeding, involves breeding different varieties or even species to combine the best **characteristics** of both. For example, female horses can be bred with male donkeys to produce mules. Mules are a **hybrid** of horses and donkeys, and they are tough, like donkeys, but agile, like horses. They make very good work animals.

A donkey (top) crossed with a horse (left) yields a mule (right).

Border collies are excellent herders.

Although many dog breeders raise dogs only for show, many dog breeds are bred for specific purposes, such as hunting, herding, or guarding. Some of the earliest hunting dogs were spaniels. Spaniels such as the familiar springer and cocker spaniels were first bred in Spain to hunt water birds like ducks or land birds like pheasants. Dog breeders determine the traits they want a dog to have and then select parents that, when bred, will pass on those traits to their offspring.

Herding is another desirable trait that is bred into some dogs. Herding dogs are used to protect and round up cattle and other livestock. Border collies and Australian shepherds are popular herding dogs. They have been so well bred that they continue to herd animals even if they aren't trained to. Many people who own border collies report that their dogs attempt to herd cars and even people!

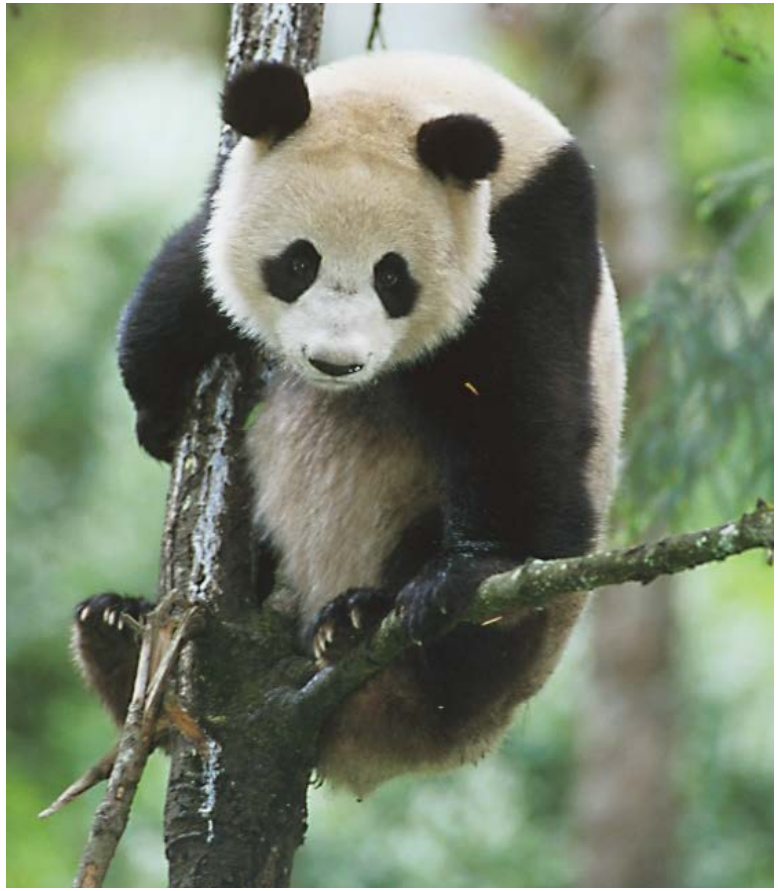
The border collie breed was developed hundreds of years ago. It was originally used to herd cattle and sheep along the English-Scottish border.

The Australian shepherd was developed from several herding breeds, including the border collie, which English settlers brought with them to Australia. These shepherds are still widely used in Australia, where cattle and other livestock are raised in open fields.

Some dogs are bred as guard dogs. The Doberman pinscher and the German shepherd are two common guard dogs. The Doberman was first bred by a German watchman named Louis Dobermann in the late 1890s. The breed has a reputation for being ferocious; however, recent breeders have worked hard to make the Doberman a more calm and friendly dog.

Many dogs are hybrids—crosses between two or more breeds. Some people believe that hybrids make the best pets because they combine the best traits of both parents.

Mutts combine the best traits of many breeds.



Pandas have benefited from captive-breeding programs.

Animals in Zoos

Many zoos perform animal research and provide education and entertainment. Some zoos use genetics in their research. This research is conducted to ensure that animal species survive well into the future. Genetics play an important role in protecting many endangered and threatened animal species.

One technique that zoo scientists use to increase the populations of endangered species is **captive breeding**. Captive breeding is the breeding of animals that are living in captivity (such as in zoos) in order to maintain genetic diversity within a species. Some offspring bred in captivity are released into wild populations to introduce different **genes** that give them a better chance at survival. This type of captive breeding is only successful if the animals can survive and reproduce on their own once they are released into the wild. Captive breeding is being used with certain endangered and threatened species, such as the red wolf, gorilla, panda, cheetah, and rhinoceros.

Another type of captive breeding is often done with species that are nearly extinct and cannot survive in the wild. It gives the animals a chance to reproduce in an environment where they are protected. Although captive breeding is important, it cannot replace animals living and breeding in the wild. Zoo employees also try to educate people about the importance of protecting the **habitats** of endangered and threatened species. If wild animals such as rhinoceroses and tigers are not protected, future generations of people will only be able to read about those animals in books.

Solving Crimes

Today, detectives have more clues to work with than ever before.

When crime solvers put on their detective hats these days, they have more to work with than a magnifying glass. Police, detectives, and lawyers now use genetics and **DNA** to help them solve crimes.

All genes contain DNA. DNA carries the code that determines an organism's genetic traits. Like fingerprints, every organism's DNA is different.

By fingerprinting criminals, police can keep a database of fingerprints. When they find fingerprints at a crime scene, they match them with the fingerprints of known criminals in the database.

Because, like fingerprints, DNA is unique, we use the term *DNA fingerprinting* for the use of DNA to solve crimes. The advantage of using DNA is that you do not need to find a fingerprint. To get a DNA fingerprint of a criminal, all you need is a small bit of skin, a single hair, or a drop of fluid such as blood or saliva. It is almost impossible for a criminal not to leave behind a trace of skin, hair, or fluid. Everywhere a person goes, he or she leaves microscopic traces of DNA.

A lab agent works on DNA evidence.

For example, if investigators find skin cells under a victim's fingernails, they can determine the DNA of the skin cells. They then take a DNA sample from the suspect. If the two samples match, the investigators are closer to solving the crime.

Law enforcement agencies are now building databases of DNA samples, much as they keep collections of fingerprints. These databases contain the DNA fingerprints of convicted criminals as well as other evidence found at crime scenes. DNA also has been used to free people who were wrongly convicted of crimes.

DNA fingerprinting has helped solve many crimes since it was first used in 1985. However, some people are concerned about possible contamination affecting the accuracy of DNA testing as well as its possible misuse. Even so, DNA fingerprinting will continue to be used as long as it helps identify criminals and solve crimes.

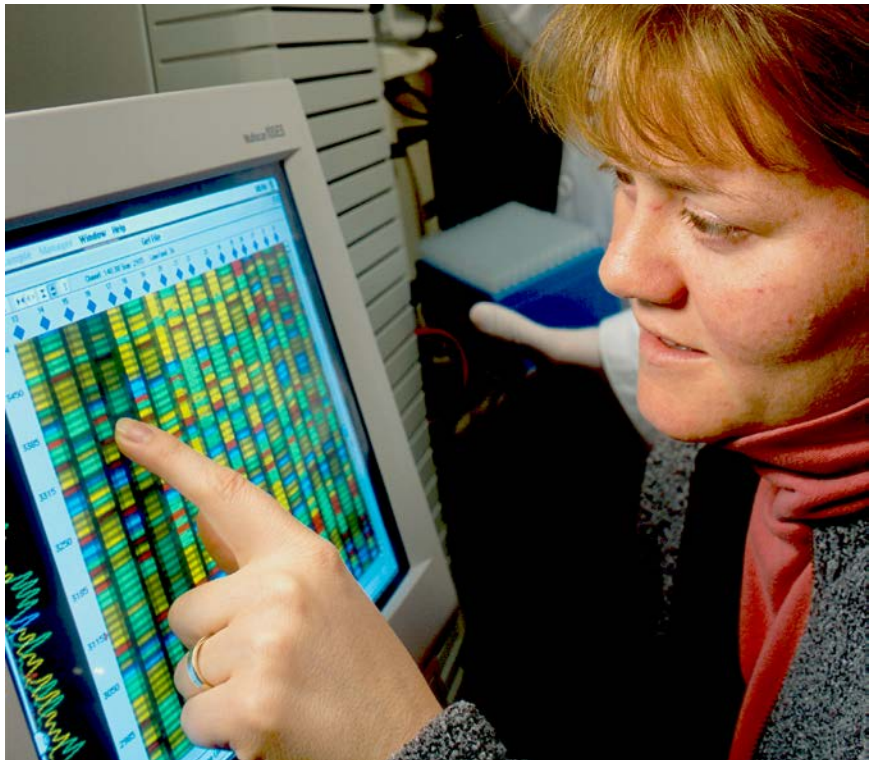
Health

Genetics is also used by many medical and health-care scientists. Genetics is used to diagnose, treat, and prevent diseases as well as to develop new medicines. Medical scientists are now discovering many genes that cause specific diseases. Identifying genes that cause a specific disease helps scientists develop medicines and vaccines to cure or prevent the disease.

Genetics counselors also use genetics. They help parents and future parents figure out the odds of passing on genetic disorders to their children. Parents use this information to help them decide whether to have children or how to cope with the possibility of caring for children with genetic disorders. Some common genetic disorders that may be passed on from parents to their children are cystic fibrosis, Huntington's disease, and breast cancer.

Do You Know?

In 2000, scientists completed the Human Genome Project, a full map of the location of every human gene. Humans have about twenty-four thousand genes arranged in a specific order on our chromosomes. It took powerful computers ten years to count and locate them all. Many diseases are caused by genes that are missing or in the wrong place.



A scientist compares DNA fingerprints on a computer screen.

Conclusion

The field of genetics offers many job opportunities. Genetics is an exciting and relatively new branch of science that brings new developments and new opportunities almost daily.

Whether in plant and animal breeding, medicine, criminology, or some other field, many career opportunities are linked to genetics. Check the library or the Internet for more information about this exciting field of science.

Glossary

captive breeding *(n.)*	the breeding of animals that live in captivity for release into the wild (p. 11)
characteristics *(n.)*	features that help to identify a thing or group of things (p. 7)
diversity *(n.)*	a wide variety of many things (p. 6)
DNA *(n.)*	a code that carries genetic information about a living thing; abbreviation of deoxyribonucleic acid (p. 12)
genes *(n.)*	basic units of heredity that transfer traits from one generation to the next (p. 11)
genetics *(n.)*	the field of science that studies how traits are passed on from one generation to the next (p. 4)
habitats *(n.)*	the natural environments of plants or animals (p. 11)
hybrid *(n.)*	offspring produced from two different parent types, breeds, or species (p. 7)
hybridization *(n.)*	the process of breeding two different species to combine characteristics of both (p. 7)
selective breeding *(n.)*	the interbreeding of selected plants or animals for the purpose of improving or controlling the traits inherited by their offspring (p. 5)
species *(n.)*	a group of living things that are physically similar and can reproduce (p. 6)
traits *(n.)*	features or qualities of an animal, plant, thing, or group (p. 4)