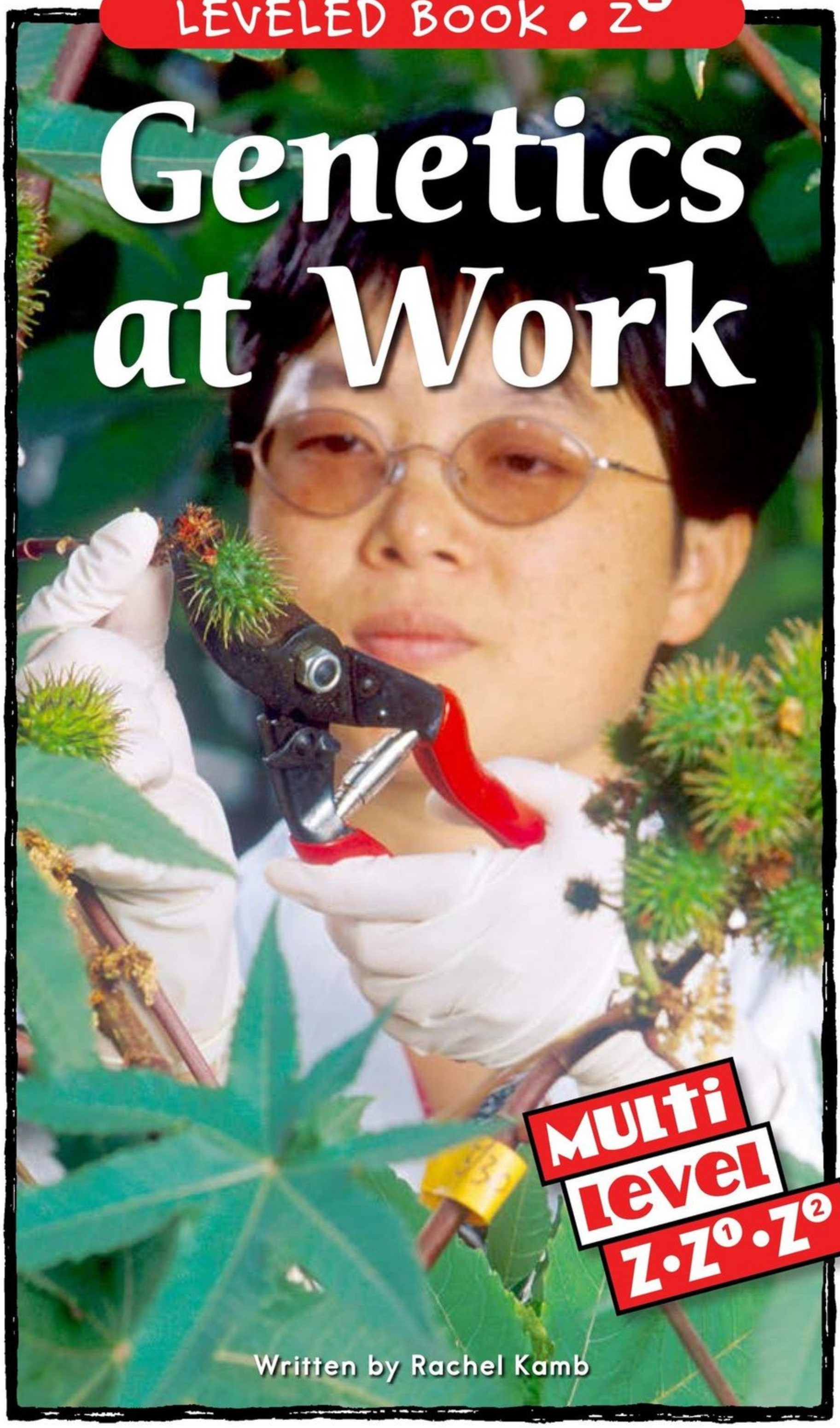
LEVELED BOOK • Z²

Genetics at Work



Multi level Z·Z¹·Z²

Written by Rachel Kamb

www.readinga-z.com

Genetics at Work

Written by Rachel Kamb

www.readinga-z.com

Focus Question

How has the science of genetics evolved over time?

Words to Know

alleles
captive breeding
characteristics
chromosomes
DNA
enzymes
genes
genetics
genus
hybridization
inherited
propagate
selective breeding
sterile
traits

Photo Credits:
Front cover: courtesy of Brian Prechtel/USDA/ARS; back cover, title page, page 20: courtesy of Keith Weller/USDA/ARS; page 5: courtesy of Bill Branson/National Cancer Institute; pages 6, 8: courtesy of Scott Bauer/USDA/ARS; page 7: © Burke/Triolo/Brand X Pictures/PictureQuest; pages 10 (top), 15: © Photodisc; pages 10 (bottom), 14, 16: © ArtToday; page 11: © Pixtal/SuperStock; page 12: © Arco Images GmbH/Alamy; page 13: © Hemera Technologies/Jupiterimages Corporation; page 17: © Jupiterimages Corporation; page 19: © Ron T. Ennis/MCT/Landov; page 21: PA Images/Alamy Stock Photo

Genetics at Work
Level Z2 Leveled Book

Written by Rachel Kamb

www.readinga-z.com

Correlation

LEVEL Z2	
Fountas & Pinnell	Y–Z
Reading Recovery	N/A
DRA	70+

Table of Contents

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 maybe you want to work with animals on a farm or in a zoo, or raise your own dogs. There is one thing you may not have thought about that all these jobs have in common . . . **genetics**!

What is genetics? Think about all the members of your family. Do you notice any similarities? Perhaps you all have the same hair color, or maybe many of you have long fingers or small noses. Things like hair color and body shape are **traits** that can be passed down to you from your grandparents and your parents, sometimes skipping a generation or two. So when someone says you **inherited** your eyes from your mother, they mean your mom passed that trait down to you.

Genetics is the field of science that studies how all living things pass on these traits through **genes**—units of heredity that determine traits in all living things. Scientists once thought that humans had about two million genes, but since the Human Genome Project began its research in the 1990s, that number has been revised to about twenty-four thousand. That's a little more than the number of genes in a chimpanzee but not as many

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

as scientists first thought. **Alleles** are different versions of genes. Many genes have two alleles; for example, one allele of a gene will pass on brown eyes and another will pass on blue eyes. Other genes have three or more alleles; for example, the alleles for blood type are A, B, and O.

Genes are made of deoxyribonucleic (dee-AHK-see-rye-bow-noo-KLAY-ik) acid (**DNA**), which is the code for your body to make the things it needs, such as **enzymes** for food digestion and pigment for eye color. DNA forms itself into shapes that are called **chromosomes**. Each cell in the human body has forty-six chromosomes—twenty-three from the mother and twenty-three from the father. It is the combination of chromosomes from both parents that makes you who you are.

You may be wondering what being a detective and raising dogs have to do with genetics. You will soon find out that genetics has a lot to do with these jobs and others, including farming, animal breeding, 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. Many of these simple techniques are still used today.

Selective breeding is one of these techniques. This technique involves scientists selecting plants with **characteristics** they like, such as quick-growing or attractive fruit, to breed with other plants that have those same characteristics or other desirable characteristics. By selectively breeding these plants, scientists ensure that the plants' good traits are passed on to create crops that grow faster and produce better fruit or have other characteristics they like.

Most of the foods we eat have been genetically modified, either through breeding or technology.

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. Some common characteristics that scientists try to **propagate** are faster-growing and more plentiful crops, better color and taste, durability, and resistance to disease. Wheat, soybeans, and corn are other common crops that are grown using genetic techniques.

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

In the future, scientists hope to have even more control over crops. With the help of genetics, farmers will be able to grow plants for us to eat that have higher protein, lower oil, and the ability to grow faster than previous versions.

Scientists also use genetic techniques with animals. For example, they use genetic breeding techniques to create chickens that lay more eggs. They produce pigs and cattle that contain meat with more or less fat, depending on how people like it. They create cows that grow faster and produce more milk. They haven't yet figured out how to get them to produce chocolate milk, but they are probably working on it!

Genetics sounds like a great thing for farming. Why wouldn't people want crops that grow faster and taste better, cows that produce more milk, and meat that is low in fat? Well, some say that genetically altering crops and animals will damage their genetic diversity. By only breeding for a select group of traits, many other useful 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.

What happens when you crossbreed two entirely different species of animals, like a dog and an elephant? Do you get barking elephants or dogs with trunks? This type of interspecies breeding is quite complex and might seem ridiculous, but scientists are currently experimenting with crossbreeding different species. Some people are worried that these creations might have a negative effect on the environment and on people.

Selectively bred piglets grow up faster than their wild cousins.

Not all combinations are possible, though, as most genetic crossbreeds occur within the same **genus**. For example, for any two species to interbreed successfully, they must have chromosomes that match up. In general, offspring from animal crossbreeding are **sterile** because of genetic problems in the hybrids. In plants, however, these hybrids are fertile and may produce more disease-resistant crops or flowers of rare beauty.

In the future, you will probably hear a lot about this issue. People in favor of genetically altered plants and animals want to improve food productivity. Those against using genetics are concerned about the unknown effects it might have on the environment and on human health.

Do You Know?

Scientists have created GMOs (genetically modified organisms) by snipping individual genes from one organism and implanting them in another. Some GMOs provide food with extra nutrients, such as adding vitamin B to rice, while others create crops with built-in pesticides and preservatives. But there are concerns about GMOs. The European Union has banned GMOs until further studies are done. Many in the U.S. call for a labeling system that identifies foods containing GMOs.

Animal Breeding

Animal breeders use some of the same genetic techniques as plant scientists, including 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 that are tough, like donkeys, but agile, like horses. They make good work animals, but they cannot reproduce.

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

Although many dog breeders raise dogs only for show, many dog breeds have been bred for specific purposes, such as hunting, herding, or guarding. Some of the earliest hunting dogs were spaniels, such as the familiar springer and cocker spaniels, which 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.

Spaniels are bred in large and small versions. Today, the larger dogs are known as setters, such as the Irish setter. They earned the name *setter* because they "set," or crouch, when locating wild game.

Irish setters

Border collies are excellent herders.

The ability to herd is another desirable trait that has been 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 that 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 have been bred as guard dogs. The Doberman pinscher and the German shepherd are two common guard dogs. Dobermans were first bred by a German watchman named Louis Dobermann in the late 1890s. The dogs have a reputation for being ferocious; however, recent breeders have worked diligently to make Dobermans a calmer, friendlier breed. German shepherds were first bred in 1899 and are descended from old breeds of herding and farm dogs. These dogs can be trained to perform many different jobs, from herding to police work to leading blind people. Many dogs are hybrids—crosses between two or more breeds, commonly called *mutts*. 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

In addition to providing education and entertainment, many zoos are also places for animal research. Genetics is an area of animal research that is performed in some zoos and is conducted to ensure that animal species survive well into the future. Genetics plays an important role in protecting many endangered and threatened animal species.

One technique that zoo scientists use to increase endangered species populations is **captive breeding**, which 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 the species a better chance of 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 many endangered and threatened species, including the red wolf, gorilla, panda, cheetah, and rhinoceros.

A cheetah

Another type of captive breeding is often conducted 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 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 them in books.

Do You Know?

Red and gray wolves are the only two species of wolves known in the world. The endangered red wolf is found in the southeastern United States. The gray wolf is found in arctic and subarctic regions around the world.

The once-common gray wolf has only recently been brought back into the United States.

Solving Crimes

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

A lab agent works on DNA evidence.

All genes contain DNA—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. Many criminals are aware that fingerprints are used to solve crimes, so they wear gloves or wipe away their fingerprints.

To get a DNA fingerprint of a criminal, all you need is a small piece 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.

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, and if the two samples match, the investigators are closer to solving the crime.

Thomas McGowan (center, with his lawyers) was released from jail after being falsely imprisoned for twenty-three years. DNA evidence proved that he could not have committed the crime of which he had been accused.

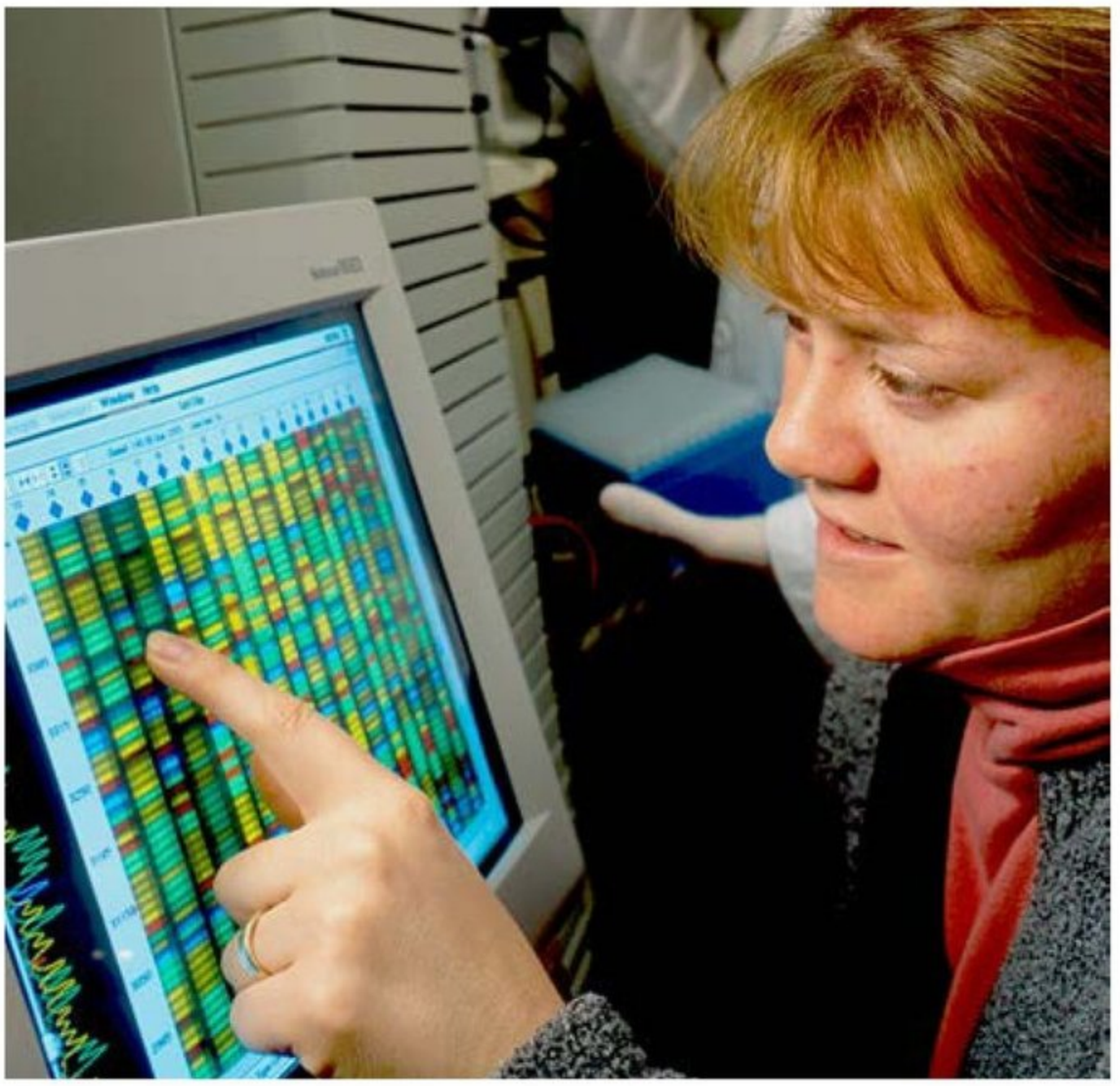
Law enforcement agencies are now building databases of DNA samples, much as they keep collections of fingerprints. These databases contain the DNA fingerprints of convicted criminals as well as other evidence found at crime scenes. DNA has even been used to free people who were wrongly convicted of crimes.

DNA fingerprinting has helped solve many crimes since it was first used in 1985. However, some people are concerned about the 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 used by many medical and health-care scientists. It 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. By identifying genes that cause a specific disease, scientists can develop medicines and vaccines to cure or prevent the disease by targeting the treatments to those specific genes.

Genetics counselors also use genetics to help parents and future parents figure out the odds



Scientists use DNA sequencers to compare relationships between different DNA samples. This information can help parents learn if their children will inherit certain diseases.

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.

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, career opportunities linked to genetics abound. Check the library or the Internet for additional information about this exciting field of science.

Dolly

Do You Know?

The first healthy mammal ever cloned was a sheep. Cloning is the creation of an exact genetic copy of a particular living thing. The first cloned sheep, born in February 1997, was named Dolly.

Explore More

1 At the Library

Ask your librarian where you can find books about genetics.

2 On the Web

A. In the address window, type: *www.google.com*.
B. Then type: *genetics*. Click on "Google Search."
C. Read the colored links. Click on one that looks interesting.
D. When you want to explore other links, click the back arrow on the top left.
E. Or try some different searches: *selective breeding, genetic diversity, hybridization, captive breeding,* or *DNA evidence*.

3 In the News

Genetics is still a new and controversial field of science. Check out local and national newspapers, news magazines, television, and radio for these genetics topics:

A. Crimes that have been solved using DNA
B. Experiments in cloning
C. New medicines developed using genetics
D. Controversy over genetically modified foods and animals

Glossary

alleles *(n.)* alternative forms of a gene (p. 5)

captive breeding *(n.)* the breeding of animals that live in captivity for release into the wild (p. 15)

characteristics *(n.)* features that help to identify a thing or group of things (p. 6)

chromosomes *(n.)* rod-shaped structures inside cells that carry genes (p. 5)

DNA *(n.)* a code that carries genetic information about a living thing; abbreviation of deoxyribonucleic acid (p. 5)

enzymes *(n.)* proteins in plants and animals that cause certain natural chemical reactions (p. 5)

genes *(n.)* basic units of heredity that transfer traits from one generation to the next (p. 4)

genetics *(n.)* the field of science that studies how traits are passed on from one generation to the next (p. 4)

genus *(n.)* a group of related species that share common characteristics (p. 9)

hybridization *(n.)* the process of breeding two different species to combine characteristics of both (p. 10)

inherited *(adj.)*	received from parents or other ancestors (p. 4)
propagate *(v.)*	to create over and over; to reproduce (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. 6)
sterile *(adj.)*	not able to produce offspring (p. 9)
traits *(n.)*	features or qualities of an animal, plant, thing, or group (p. 4)

Index

Genetics at Work

A Reading A–Z Level Z2 Leveled Book
Word Count: 2,175

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.