Introduction

Fashion Through History

What part do science and engineering play in the fashion industry?

From sewing machines to synthetic dyes, science and engineering have made the fashion industry possible. Through time, people have been inspired to invent new methods of producing fabric and putting it together in ways that reflect the values and needs of their culture.

What are you wearing right now? Jeans, joggers, sneakers, a vintage shirt, and sunglasses? What about earrings? Your fashion choices play an important part in your life. They help shape the world's impression of you, support your sense of belonging in various groups such as a sports team or cultural club, and define your comfort levels, both physically and emotionally.

Have you ever worn an outfit that felt okay when you put it on in the morning, but by midday, you wanted to get it off? Do you have a certain outfit that you wear whenever you need a confidence boost? That's the power of fashion.

The daily ritual of picking out the day's outfit is probably part of your morning routine. But how often do you actually think about how fashion affects your everyday life or how your choices go beyond your personal world? Do you ever wonder how the creation of the clothes in your closet influences global economies or impacts the earth's environment?

You might be thinking, "Seriously? Global economies and the environment? It's just a T-shirt and a pair of jeans. What's the big deal?"

Who knew fashion was so important?

FASHION CHOICES: IT'S GLOBAL

The newest fashions in 1829

The truth is, fashion is a big deal, especially when combined with the choices of everyone else in your school, your city, and your country. Whether you are a fashionista or a wear-the-same-thing-every-day kind of person, your clothing choices are just a small piece in a worldwide puzzle.

Clothing choices affect global economics because fashion is a $1.2-trillion industry, employing millions of people all over the world. Your choices affect the environment because the fashion industry is one of the largest polluters in the world, second only to the oil industry.

Finally, your fashion choices affect and are affected by the world of science and engineering. Everything you wear is the product of a long line of scientific and technological advances. These include the highly automated machines fabric is made on, the synthetic fabrics created in a lab, and the engineering behind smart textiles.

Fashion today

Science, engineering, technology, and fashion are truly interwoven in a mutually beneficial and reciprocal way. In other words, the continued growth of the fashion industry is dependent on the knowledge and technology gained from scientists and engineers. On the flip side, the scientific, engineering, and technological advances gained in the fashion industry are applied to other fields and industries.

The combined efforts of science, engineering, and fashion have created a global industry that affects people, economies, and environments all around the world.

CHA-CHING

The fashion industry is an economic powerhouse in today's global economy. As of 2015, according to the Joint Economic Committee of the U.S. Congress, fashion is a $1.2-trillion industry. More than $250 billion is spent on fashion annually in the United States alone. Start to finish, from making textiles to selling clothing in stores, the fashion industry employs more than 60 million people globally.

CLOTHING CHOICE: IT'S PERSONAL

True, fashion is a global industry, but fashion is also personal. Obviously, you wear clothing to protect yourself from the elements. However, there are other, less obvious factors that influence your clothing and fashion choices.

One important factor is whether your choice is socially acceptable for the community or culture in which you live.

In all cultures, there is a sense of what is viewed as appropriate and inappropriate clothing for work and school, for adults and kids. If your clothes don't fit into that, you might be stared at, judged, or even punished for being "different."

Often, schools and work environments have dress codes that outline the appropriate clothing choices for that environment.

This idea of socially acceptable clothing applies to peer groups as well. Think about your group of friends. Chances are, no one has handed out a printed dress code of what you can and cannot wear, but if you take a look around, you will see that everyone sticks pretty close to the unspoken dress code, whether that's jeans and T-shirts, high-end athletic leisurewear, or cowboy boots and a cowboy hat.

Religious affiliation might also decide, or at least influence, what you can and cannot wear. For instance, a hijab is worn in public by some Muslim women. A conservative Christian community might not allow girls to wear short shorts or short skirts, while men in Amish communities might be required to wear specially made dark suits without lapels that fasten with hooks rather than buttons.

A person's choice of clothing is also dependent on the day's activities. High heels and tight pants might be a perfect outfit to wear for a job as a salesperson in a high-end clothing store, but might not be the smartest choice for a construction site or for lawn work. If your day involves a special occasion, there might be some fashion requirements for that, too.

SCIENTIFIC METHOD

The scientific method is the process scientists use to ask questions and find answers. Keep a science journal to record your methods and observations during all the activities in this book. You can use a scientific method worksheet to keep your ideas and observations organized.

Question: What are we trying to find out? What problem are we trying to solve?

Research: What is already known about this topic?

Hypothesis: What do we think the answer will be?

Equipment: What supplies are we using?

Method: What procedure are we following?

Results: What happened and why?

PRIMARY SOURCES

Primary sources come from people who were eyewitnesses to events. They might write about the event, take pictures, post short messages to social media or blogs, or record the event for radio or video. The photographs in this book are primary sources, taken at the time of the event. Paintings of events are usually not primary sources, since they were often painted long after the event took place. What other primary sources can you find? Why are primary sources important? Do you learn differently from primary sources than from secondary sources, which come from people who did not directly experience the event?

PS

Some clothes, such as sports or school uniforms, show your identity as a member or supporter of a team. Others show your profession, such as a doctor's white lab coat or a firewomen's uniform or a judge's black robes.

FABRIC FACT

On average, adults spend $161 per month on clothing and services. As people get older and make more money, they spend more on fashion.

Interestingly, all of these choices have to do with social belonging, or working to be acceptable to or part of a group. Psychologists say this is a fundamental human need and is related to a sense of happiness and well-being. Fashion and clothing choices are one way that we signal and reinforce that feeling of belonging.

As you can see, fashion choices are about a lot more than just covering our bodies. Clothing tells the world who you are, what you like, and, often, what socioeconomic group you are in.

A printed metal fabric designed by NASA engineers to be used in space

Credit: NASA/JPL-Caltech

The story you are telling about yourself through your clothing might be a true representation of who you are or it might be a made-up version of the person you want the world to see. Your clothing choices might make you look richer than you are, more athletic, older, younger, wild, or conservative. It is your story to tell.

A LITTLE FASHION HISTORY

The history of fashion and clothing can be divided into two periods—before the Industrial Revolution and after the Industrial Revolution. In both periods, science, engineering, and technology played a role. However, during and after the Industrial Revolution, thanks to innovations in technology, changes began happening faster and faster. These changes even helped eventually create the idea of fashion in the first place.

It is important to note that the history of clothing is not the same thing as the history of fashion.

When we say the word "clothing," we are simply referring to the items that are worn on the body. Fashion, however, has a somewhat different meaning. The word "fashion" refers to certain styles of dressing. These styles vary with different periods of time and different cultures, depending on the values of people at that time and place.

Think about it—a pair of pants is merely a piece of clothing that is worn to cover the lower part of the body. However, when you think about pants in terms of fashion, the pants wealthy gentlemen wore in England in 1750 are quite different from the pants worn by Western ranchers in 1900.

PS

One way scientists get involved in fashion is to study the effect of fashion choices on the individual. Take a look at what one study revealed.

Do you think you make judgments based on clothing?

PT clothes saying

Claire Distenfeld, owner of Fivestory, which is one of New York City's hippest fashion boutiques, says that fashion is "a form of expression without the use of words."

Both of those are vastly different from the joggers and blue jeans we wear today, all in the name of fashion.

Anthropologists believe that humans began wearing clothes as protection from the elements between 100,000 and 500,000 years ago. Those earliest clothes were made from animal skin, fur, or leaves that were probably wrapped, draped, or tied around their bodies.

Technology entered the picture at least 50,000 years ago. That's when simple sewing needles made from animal bones were used to sew several skins or furs together to make a more fitted garment.

Researchers have found evidence of primitive looms dating to around 5000 BCE. These looms mean that ancient humans had figured out a way to turn raw materials into cloth.

A CLOSE-UP ON CLOSETS

For most of human history, closets were not built into houses. There was no need, since most people stored their one or two extra sets of clothing in dressers. If you were rich and had lots of room and lots of clothing, you might have a free-standing closet called a wardrobe. In fact, America's first built-in closets didn't show up until the late 1800s. The first advertised built-in closets were found in the Dakota Apartment Building in New York City, New York. Advertised as 2½ feet deep and 6 feet wide, these closets were the height of luxury.

As centuries passed, bit by bit, culture by culture, societies slowly began to come up with more sophisticated ways to make textiles and clothing. Still, every piece of clothing was made by hand. First, the cotton or flax or sheep had to be raised, and then their fiber was harvested, cleaned, and spun into yarn or thread. That yarn was woven into a piece of material that was then cut and sewn by hand into a simple piece of clothing.

We will learn more about this process in the next chapter, but making clothing was certainly an extremely labor-intensive endeavor. Layer that in with all of the other work a person needed to do to survive, since there were no quick runs to the grocery store, no electric furnaces, and no construction companies to build homes. People had to raise food, chop wood for heat, and build their own shelters.

You can see that having a closet full of clothes to choose from each morning in order to get ready to go to school—though school wasn't a daily reality for most people—was not a feasible option. Even the richest people, who could afford to have others make their clothing for them, didn't have the luxury of having lots of different outfits in their closet. In fact, they didn't have closets either.

THE INDUSTRIAL REVOLUTION CHANGES EVERYTHING

When the Industrial Revolution occurred, everything changed in a fairly short amount of time. These changes began in Great Britain in the late 1700s, but eventually spread around the world in the mid-to-late 1800s.

ENGINEERING DESIGN PROCESS

Engineers recognize, define, and analyze problems. They use science and math to solve these problems, often creating special technology or tools in the process. This method of problem solving is called the engineering design process. This approach recognizes that there might be several solutions to a problem. Engineers choose an option, test it, evaluate it, and adjust. Many engineers use a worksheet like this one to keep their thoughts organized.

Problem: What problem are we trying to solve?

Research: Has anything been invented to help solve the problem? What can we learn?

Brainstorm: Draw lots of designs for your device and list the materials you are using!

Prototype: Build the design you drew during brainstorming.

Test: Test your prototype and record your observations.

Evaluate: Analyze your test results. Do you need to make adjustments? Do you need to try a different prototype?

TRAITOR OR KEEN BUSINESSMAN?

Samuel Slater (1768–1835) was dubbed the "Father of the American Industrial Revolution" by U.S. President Andrew Jackson (1767–1845). In Great Britain, however, he was called "Slater the Traitor." As a teen growing up in Milford, England, Slater worked as an apprentice in a textile factory, where he memorized the designs of the machinery. In 1790, a 21-year-old Slater emigrated to the United States and convinced the owner of a textile mill that he was an expert at building textile machinery. Turns out, he was! Slater soon built, from memory, several of the machines he had worked on as an apprentice. By 1793, having gone into business with that same owner, he established the first successful textile mill in the United States.

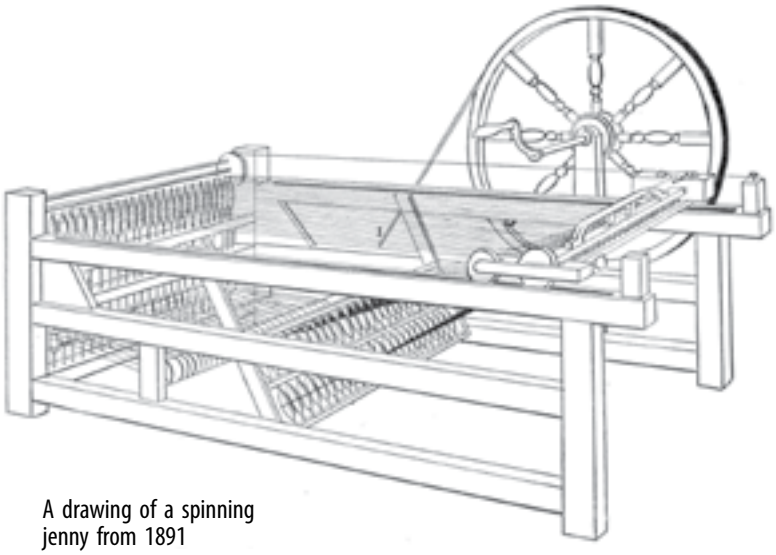
Thanks to scientific and technological advances, societies changed from rural and agrarian communities where everything was made by hand. They became industrial societies where engines and machines could more efficiently and effectively do the work once done by individuals. As time went on, advances in engineering and technology introduced new methods and machines.

Several innovations stand out as truly important in catapulting clothing manufacturing into the future.

Prior to the spinning jenny (invented in 1765), the spinning of fiber into yarn was generally done at home. One person sat at a spinning wheel, painstakingly spinning a single spool of yarn. It was slow and tedious work!

The spinning jenny was a hand-powered spinning machine that allowed a single spinner to operate eight spools at once, thus reducing the amount of work required to make yarn. This invention was soon replaced by the water frame, which was powered by a water wheel. Patented by Richard Arkwright (1732–1792) in 1769, the water frame could spin 128 spools at a time. Since yarn is woven together or knitted to make cloth, the more yarn that is spun, the more cloth that can be made.

The next innovation was the power loom, designed in 1784 by Edmund Cartwright (1743–1823) and built in 1785. Power looms made the production of cloth faster and required much less human labor. The more cloth that was made, the more demand there was for it.



A drawing of a spinning jenny from 1891

Great Britain, home of these inventions, soon had a flourishing textile industry that controlled the world textile market. In order to protect their inventions and their businesses, Great Britain created laws that made it illegal to send their machines overseas or for textile mill workers to move to other countries.

The cotton gin, invented by Eli Whitney (1765–1825), was another significant technological step. Patented in 1794, it created an automatic way to remove the cotton fiber from the cotton seeds. This provided a much quicker means to harvest cotton, which in turn allowed the American South to plant more cotton.

The invention of the cotton gin also created the need for more slaves to tend the crops. Had the cotton gin not been invented, slavery might have ended sooner in American history.

A cotton gin at work in the 1940s

PS

Take a look of some of the marvelous machines invented during the Industrial Revolution.

Can you spot the spinning jenny?

ThoughtCo Industrial Revolution

Many of the people mentioned in history are white men. Why? They had better access to education and opportunity. People of color and women were denied opportunity through formal laws and regulations as well as societal prejudice. Before the Civil War, it was illegal for slaves in the South to get an education, own land, and obtain patents on the inventions they created. After the Civil War, Black people still faced discrimination and prejudice. But that doesn't mean Black people weren't inventing. You can read some of those stories at this website.

How are people of color still affected by prejudice today?

Nat Geo African American inventors

The sewing machine has a long and complicated history of invention. Many inventors took a swing at it, including Elias Howe (1819–1892), who patented his lockstitch machine in 1846. Initially, it did not sell well, but with modifications and improvements from Isaac Singer (1811–1875) and Allen Wilson (1824–1888), the final version worked more easily and efficiently. The first home sewing machine was sold in 1889.

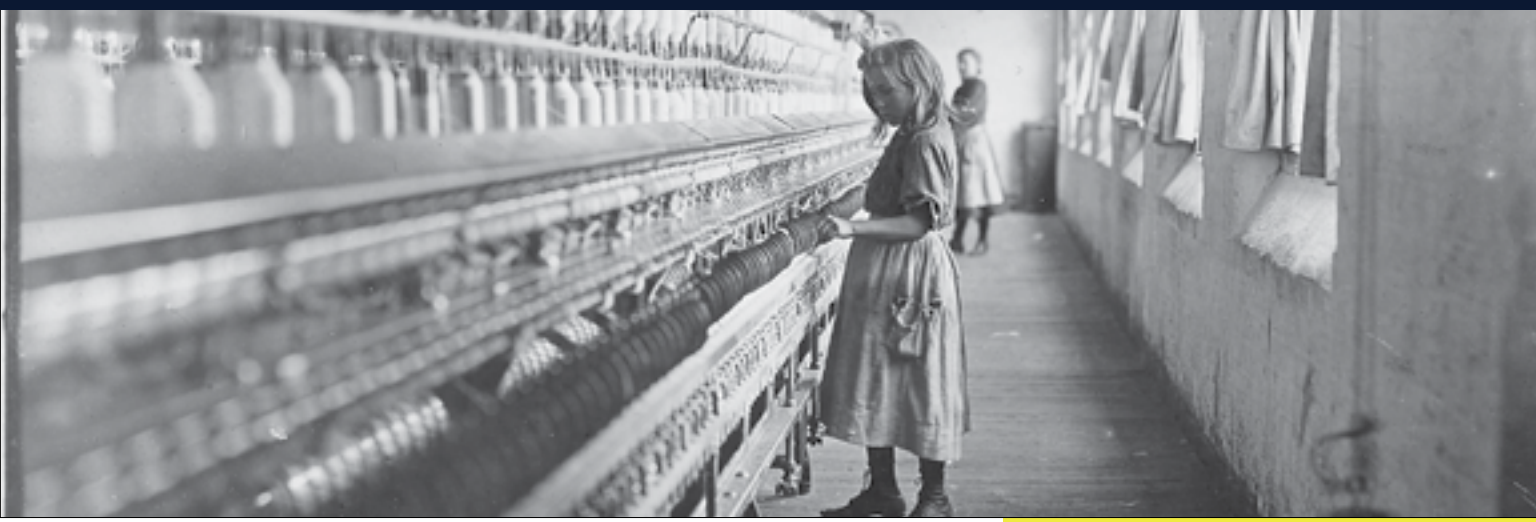
Before the invention of the sewing machine, seamstresses sewed each piece of clothing by hand, individually fitting it to each customer. An experienced seamstress could sew about 40 to 50 stitches per minute, while the new sewing machines could sew about 900 stitches per minute. The time per outfit went down greatly, which meant profit went up.

FABRIC FACT

Synthetic fabrics now fill everyone's closets, but rayon, the first manmade fabric, wasn't available commercially until 1910. Nylon came along in 1939 and disco dancers and bike racers were thrilled to welcome spandex into the world in the 1970s.

What about making the fabric beautiful? Long before dyes were made in laboratories, they were made in homes from natural resources such as fruits and berries and nuts. The first synthetic, or manmade, dye was accidentally created in 1856 by an 18-year-old British chemist named William Henry Perkin (1838–1907).

Perkin was attempting to create a synthetic version of quinine, a plant used to treat malaria. Instead, he came up with a mixture that made a purple dye that would eventually become very popular in Great Britain. This discovery led to more work by other chemists trying to create different synthetic dyes.



Child labor was commonly used in cotton mills. Children's small hands and fingers could be useful working in machines where adult-sized hands wouldn't fit.

Credit: Lewis Hine

Often, when people think of the jobs in the fashion industry, they immediately think of a fashion designer. And, of course, the fashion industry is dependent on the skills and vision of these creative people. But it is important to remember that fashion designers do not work alone. Beside them work a whole fleet of science, technology, engineering, and math (STEM) professionals.

The fashion industry has many branches and requires many types of skill sets. In this book, we'll explore the role science, engineering, and technology play in the fashion industry, including changes in fabric, color, design, accessories, and shoes. We'll also look at some of the different jobs and specialties that keep fashion growing and changing.

Ready to stroll down the runway? Let's go!

KEY QUESTIONS

- **How did the Industrial Revolution change the clothing and fashion industry?**
- **Why do we know less about women and Black people in the history of textiles?**
- **What is the relationship between fashion designers and textile manufacturers?**

TEXT TO WORLD

How is the clothing that you wear to school different from the clothing you wear to play sports? Why?

Inquire & Investigate

THE STEM IN YOUR CLOSET

Have you ever really thought about what kinds of science, engineering, and technology actually go into making your clothes? Now is your chance! The zipper on your jacket was at one time an engineering miracle. The shirt that has built-in protection from the sun's ultraviolet rays is a scientific innovation that helps to keep you healthy. There is a world of science and engineering in your closet. Just open the door.

- **Look at your closet through an inquisitive science and engineering lens.** Keep in mind the topics covered in this book: fabric, color, design, accessories, and shoes.
- **Make a list of the technological or scientific advancements that you notice.** You don't have to explain them all, just notice what are there and record them in your science journal.
- **Choose one advancement you found in your closet and research its history.** Who invented it? Why? How did that invention change the industry? Has anyone invented something that replaces that innovation?

To investigate more, choose one of the inventors or innovators that designed something in your closet. Were they male or female? Were they recognized for their contributions? Were they paid for their invention? Why does it matter?

VOCAB LAB

Write down what you think each word means. What root words can you find to help you? What does the context of the word tell you?

economy, **engineering**, **fashion**, **patent**, **prototype**, **synthetic**, and **textile**.

Compare your definitions with those of your friends or classmates. Did you all come up with the same meanings? Turn to the text and glossary if you need help.