
ENGINEERED PROTECTION

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INTRODUCTION



When I first began exploring the evolution of protective body armor, I was immediately struck by how advanced the technology of the modern world has become. As I continued researching, I began to wonder just how far body armor technology has actually progressed over time. With the steady advancement of weapons, changing tactics of warfare, and the persistence of violence in today's world, it became clear that body armor plays a critical role in protecting people and saving lives.

This project examines the evolution of body armor from its earliest forms to the sophisticated systems used today. While understanding the historical development of armor is important in explaining how modern designs came to exist, the primary focus of this project is on contemporary advancements, engineering challenges, and innovations in protective technology. By exploring these developments, the goal is to provide my audience with a clearer understanding of how modern body armor works and a deeper appreciation for the engineers who design it and the individuals whose lives depend on it every day.





REVISED

Research Question

How has body armor evolved over time, and what innovations have made modern armor more effective at protecting lives today?

ORIGINAL

Research Question

In what ways has the design and function of body armor evolved from its origins to the present day, and how have these developments influenced both society and modern technology?

STORYTELLING









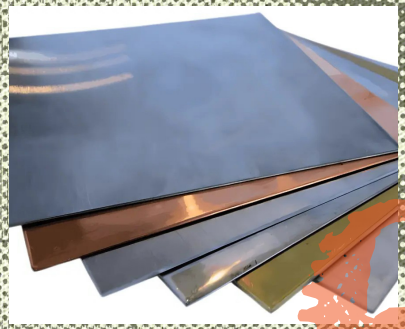




THROUGH VISUALS

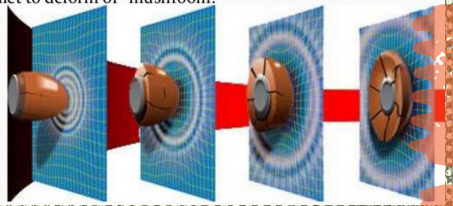






HOW IT WORKS?

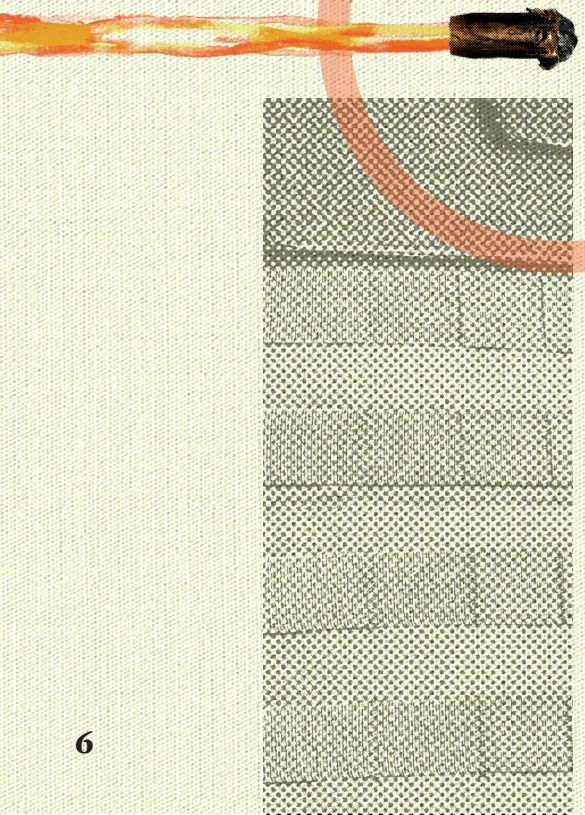
When a bullet strikes body armor, it is caught in a "web" of very strong fibers. These fibers absorb and disperse the impact energy that is transmitted to the bullet proof vest from the bullet, causing the bullet to deform or "mushroom."







TOPIC SYNOPSIS



This project examines the evolution of protective body armor from its earliest forms to the advanced systems used today. It explores how changes in materials, design, and engineering have shaped the development of armor in response to evolving weapons, warfare tactics, and safety needs. By analyzing historical examples alongside modern technological innovations, the study traces how body armor has adapted over time to provide greater protection while balancing mobility, weight, and practicality.

While historical developments provide important context for understanding modern armor, the primary focus of this research is on recent technological advancements and the engineering challenges involved in creating effective protective systems. Through this exploration, the project aims to highlight the complex design process behind modern body armor and foster a greater appreciation for the engineers and innovators who continue to improve life-saving protective technologies.



PURPOSE STATEMENT

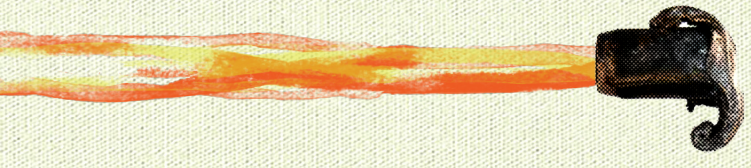
The purpose of this project is to examine how protective body armor has evolved from its earliest forms to the advanced systems used today, and to understand the technological and engineering factors that have driven these developments. By analyzing historical changes alongside modern material innovations and design challenges, this research explores how body armor has adapted in response to evolving weapons, warfare tactics, and safety needs. Through this analysis, the project aims to provide a clearer understanding of modern body armor technology and highlight the engineering efforts that make these life-saving protective systems possible.

CONNECTION TO HUMANITY



Why I Care

I care about this topic because of its deep connections to society, military practices, fashion, history, and technological innovation. Many people associate armor only with the "knight in shining armor" seen in fairy tales or medieval paintings, but its story is far more complex. Throughout history, humans have adapted the materials around them learning to harden metals, then shaping steel plates that could redirect or withstand physical strikes. As weapons evolved, so did armor, eventually leading to the development of advanced materials like Kevlar capable of absorbing the impact of modern firearms. The evolution of body armor reflects humanity's constant pursuit of protection, ingenuity, and survival, making it a topic that has been relevant from ancient times to the present day.



How Does This Topic Effect Humanity?

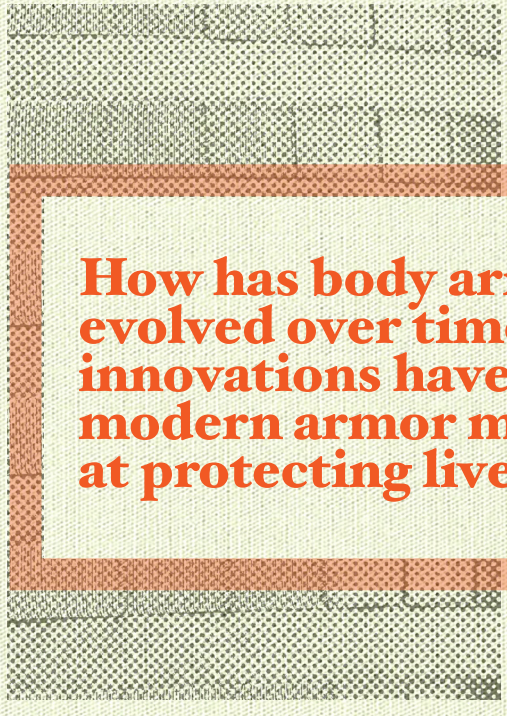
The evolution of body armor has had a profound impact on humanity by shaping how people protect themselves, engage in conflict, and innovate technologically. It increased human survivability in warfare, law enforcement, and hazardous environments, ultimately saving countless lives. Its development has also driven major advancements in materials science, engineering, and physics, influencing technologies far beyond the battlefield. Culturally, armor reflects the values, fears, and identities of different societies, symbolizing strength, status, and resilience. Because it affects public safety, technological progress, and the way conflicts are fought, the story of body armor is deeply intertwined with the story of human history and adaptation.

Who Does This Topic Effect?

The topic of body armor affects all kinds of people in both historical and modern contexts. Soldiers and military personnel rely on armor for protection in combat, making them some of the most directly impacted. Law enforcement officers, security guards, and EMS also depend on protective gear to stay safe in their field of work. Civilians living in conflict zones can be affected as improvements in armor and availability of equipment influence their safety. Beyond those who wear it, the topic also affects engineers, scientists, and manufacturers who develop new materials and technologies, as well as historians, designers, and even artists who study or draw inspiration from armor's cultural significance. In this way, the evolution of body armor touches people involved in safety, technology, arts, society, and history.



FLOW CHART

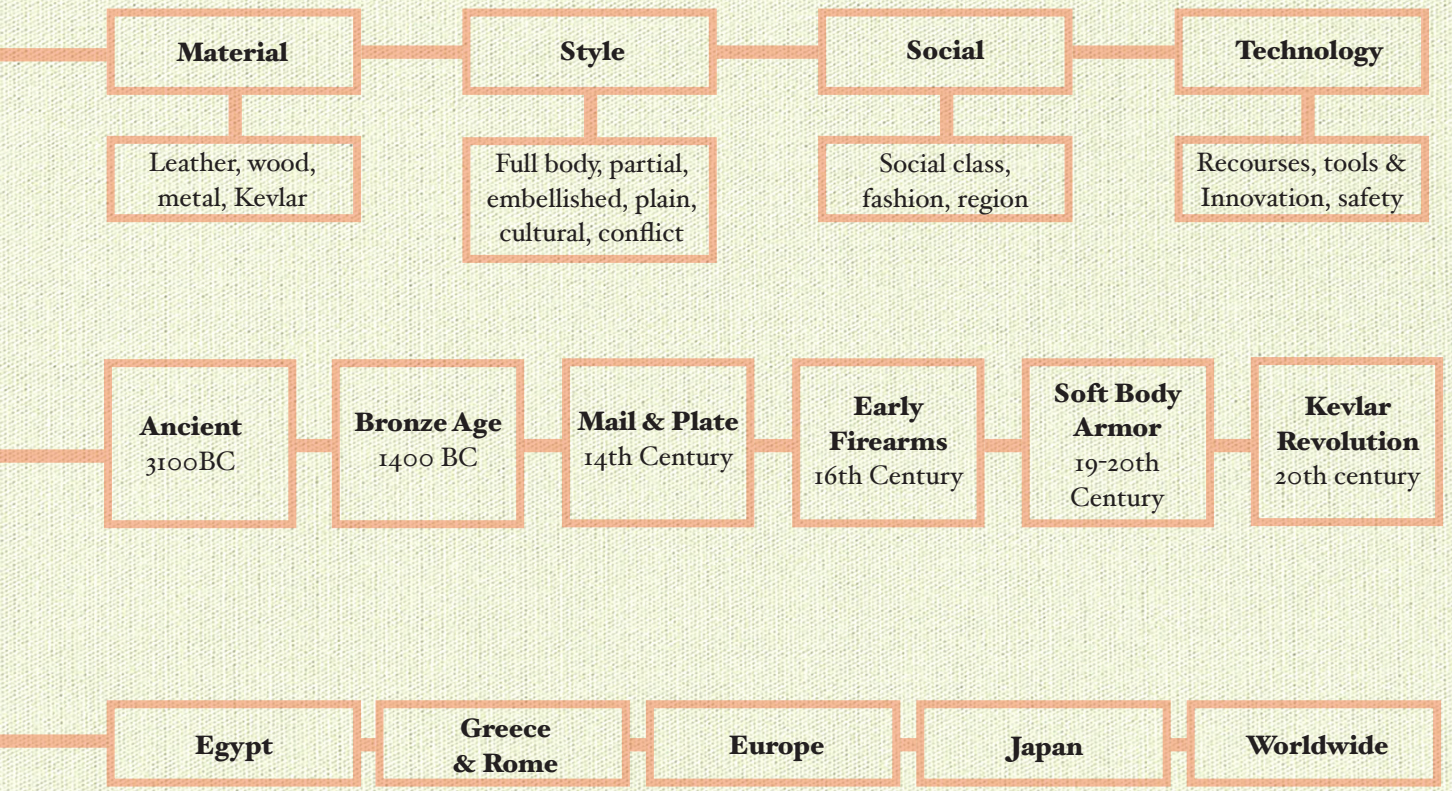


How has body armor evolved over time, and what innovations have made modern armor more effective at protecting lives today?

WHAT

WHEN

WHERE


Material
Leather, wood, metal, Kevlar
Style
Full body, partial, embellished, plain, cultural, conflict
Social
Social class, fashion, region
Technology
Recourses, tools & Innovation, safety
Ancient
3100BC
Bronze Age
1400 BC
Mail & Plate
14th Century
Early Firearms
16th Century
Soft Body Armor
19-20th Century
Kevlar Revolution
20th century
Egypt
Greece & Rome
Europe
Japan
Worldwide

RESEARCH METHODS



Information Design

A timeline will illustrate and summarize the evolution of armor in an efficient way allowing a reader or viewer to get a broad picture of armor through history without having to read large amounts of text. An effective timeline of this topic would include icons and/or images paired with dates labels and side notes.

Literature

Sourcing primary and secondary literature will supply the historical and modern knowledge required to define my topic's relevance and factual evidence.

Interviews

Interviewing people who have had first had experience with armor such as, veterans, law enforcement, fashion enthusiasts or even civilians who feel the need to be protected will support and elevate the significance of these studies as well as provide external opinions and views.

DATA COLLECTION

~ Approximate body Coverage of armor over time in a tactical setting

Ancient era → 50% – 55% (~50%)

Bronze age → 60% – 70% (~65%)

Medival Period → 90% – 100% (~95%)

Early Modern Period → 65% – 75% (~70%)

20th Century → 55% – 65% (~60%)

Modern → 65% – 75% (~70%)

bar graph

Potential Data for graphs

Location of injurys obtained in battle

41623 combat explosions 2004 – 2007

extremities – 41.3%

Head & Neck – 37.4%

Torso – 8.8%

Percentage of Combatants Dying of Wounds by Conflict by War

WWII – 30%

Vietnam – 24%

Operation Freedom – 10%

National Institute of Justice Body Armor Classification

Type	Weapon Protected Against
IIA	9mm; 40 Smith & Wesson
II	9mm; 357 Magnum
IIIA	357SIG, 44 Magnum
III	rifle, 7.62mm full metal jacket
IV	armor-piercing rifle, .30 caliber

Income vs Armor Owned

$0 – $39,999

$40,000 – $79,999

$80,000 – $119,999

$120,000 – $159,999

$160,000 and over

Defense Personnel 95 – 100%

Law enforcement 41 – 59%

Civilian 5 – 10%

US Market Value of Body Armor

2000

0	01	02	03	04	05	06	07	08	09	10	11	12	13
789.5 mill	—	153 mill	160.4 mill	354.4 mill	2.06 bill	2.07 bill	2.1 bill	2.12 bill	2.04 bill	1.31 bill	1.68 bill	1.4 bill	2.4 bill

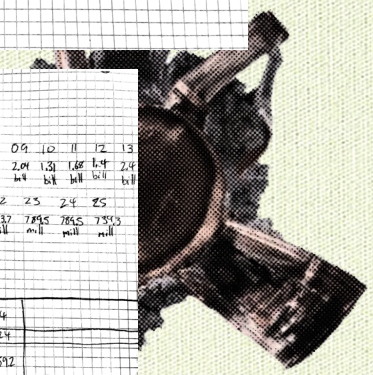
14	15	16	17	18	19	20	21	22	23	24	25
478.5 mill	627.2 mill	806.2 mill	726.8 mill	590 mill	589.5 mill	589.5 mill	592.5 mill	743.7 mill	789.5 mill	789.5 mill	759.3 mill

Online gun & ammunition sales in US in billions

0.7	0.9	1.16	1.9	3	3.2	3.4
2013	2014	2015	2018	2020	2022	2024

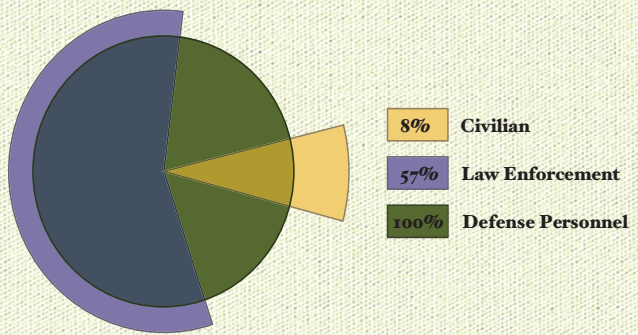
1123.1	478.5	806.2	590	589.5	743.7	7592

Body Armor Manufacturing in the US – in millions

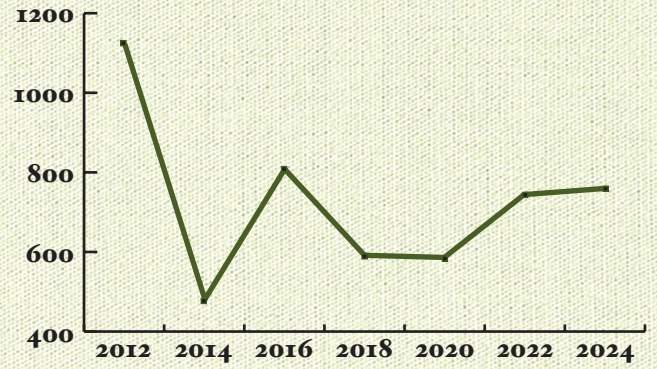


GRAPHS

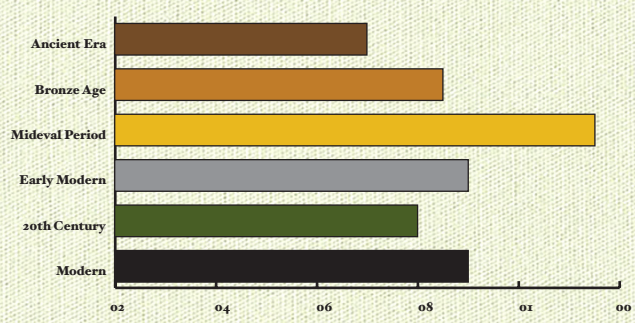
Body Armor Use Across Defense, Law, and Civilian



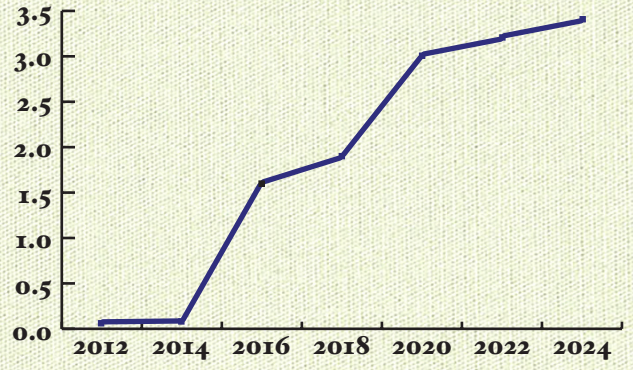
Body Armor Production in the US by the Millions



Body Armor Coverage: Ancient to Modern



Online Firearm Sales in the US by the Billions





DATA & INFO CITATION

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TIMELINE

3100 BC – ANCIENT ERA

Middle east

The earliest forms of body armor were made from leather and animal hides. This kind of armor only provided partial protection from rudimentary weapons and was commonly worn while hunting to protect against dangerous game.

Egypt

The ancient Egyptians made the earliest advancement in armor by quilting and layering linen however this new technology still only provided minimal protection.

1400 BC

Bronze Age

Bronze plate armor was introduced in Greece. This heavy armor covered the torso shoulders and sometimes arms and legs. The Greek armor was called Dendra Panoply.

500 BC

Chain mail was introduced by the Celtics. The Romans adopted this technology in later years

14TH CENTURY

Medieval Period

By the 14th century in Europe the technology of hardening metal had been perfected. This time period is associated with the full body armor. A.K.A the knight armor we all know and love. These full body suits of armor were made of hardened steel plates placed atop chain mail. These suits were very heavy and greatly restricted the knights mobility.

16TH CENTURY

Early Modern Period

With warfare steadily changing the need for flexibility and mobility became more of a focus. Soldiers began strategically placing smaller pieces of armor over the vital areas of their body. Reinforcing their plated armor with leather was found to be more comfortable and increased mobility. The discovery of buffing also reduced friction between metal plates. The introduction of firearms forced chest plates the become thicker to withstand the lead bullets.

EARLY 20TH CENTURY

World Wars

This period made a large shift in armor design. The increasing advancement of firearms made metal body armor a thing of the past. Functionality and mobility were more important than ever with war tactics and technology evolving. Soldiers would wear helmets and flack jackets which were made of ballistic nylon. These jackets were unable to stop a bullet but were effective in protecting against shrapnel from explosions.

LATE 20TH CENTURY

Kevlar Revolution

In 1965 a chemist at Du Point named Stephanie Kwolek developed the revolutionary ballistic-resistant material Kevlar. Original developed as an improvement on steel belting in vehicle tires Kevlar wasn't actually used in armor until the 1970s. This fibrous material absorbs and disperses enough energy to stop bullets and many other ballistic impacts. After the invention of this unique material Kevlar vests replaced all kinds of predated body armor being the most protective, without restricting mobility.

LATE 1970S - 80S

High-Molecular Weight Polyethylene (HMPE)

Originally invented in the 1950s to be used as artificial joints but wasn't used as armor until the 1980s. HMPE is a fibrous material similar the Kevlar but is know to be lighter, more buoyant, and more resistant to moisture and UV. Kevlar (aramid fiber) has higher temperature resistance and is more rigid

2000S - 2020S

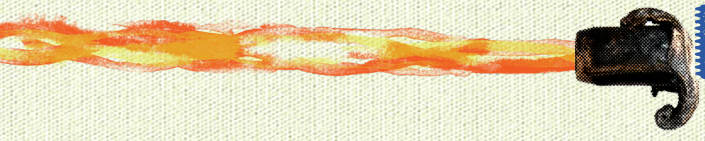
The "Iron Man" Suit

Tactical Assault Light Operator (TALOS) aka. The "Iron man" suit is described as an "exoskeleton" for soldiers the Iron man suit would provide full-body ballistic protection. Engineers are developing this suit with increased mobility, surveillance abilities and physiological performance in mind. This suit at its full potential would provide the soldier with the capacity to carry heavier loads, improve endurance, regulate body temperatures. Though integrated power sources the wearer's vitals and precise location can be tracked as well as heighten their situational awareness by utilizing complex sensor mechanisms. The engineering problem of the Iron man suit lies within the name TALOS deriving from the mythological Greek giant Talos whose only weakness was his single vein that ran from head to ankle. If the vein was damaged Talos would perish. This suit relies on a central power source to function. If this source is damaged it is fatal to the soldier.

Prototype

DESIGN PROCESS

POSTER & INFORMATION DESIGN



AUDIENCE

The main groups this poster aims to reach

Civilians

Law Enforcement

Security Workers

Historians

Engineers



MARTIN

23

Chicago, Illinois

Lower Income

Police Academy Student

Martin was raised in a low income family. He has worked as a full time landscaper for the past 5 years to enough money move out on his own however, considering his low income he is only able to afford an apartment with cheap rent in a high risk community. Martin does not see himself working as a landscaper for the rest of his life and has developed a deep appreciation for law enforcement due to the amount of crime he is surrounded by in his high risk community. He is now on his way to become a Police officer in a city with a high crime rate where body armor will soon be a vital piece of equipment in his daily life.

ASSOCIATIVE WORDS

• Metal • Wood • Leather • Matrial • Pleats • Movement
• Protection • Battle • War • weapons • Body • firearms
• sword • arrow • helmet • Gauntlet • tough • stab
• Resistant • deflect • absorb • Kevlar • ect • Coverage
• Conflict • technology • hit • strike • Mobility • charge
• Flex • social • wealth • Power • shine • plate
• soft • hard • ceramic • history • chain • mail • ballistic
• shrapnel • padding • comfort • defense • fashion • equipment
• Bullets • Flak • sheild • resistent • suit • coat • steel
• safety • cover • combat • style • gear • peice • half • full
• Modern • Midieval • knight • soldier • bulletproof • armor
• cataphract • cavalry • warfare • Egypt • Greece • America
• development • breast • vitals • weight • heavy • light
• versatile • restricting • practicality • Fiber • Cuirass
• Ancient • clothes • capitol • class • Police • Civilian • violence

Material

Technology

Kevlar

Coverage

Defense

Style

Bulletproof

Warfare

Development

Practicality

FINAL TYPE CHOICE

ENGINEERED PROTECTION

TRACING THE EVOLUTION OF BODY ARMOR AND ITS IMPACT ON MODERN SAFETY

Heading – Kiln Sans Spiked , 54pt
H2 – Kiln Sans Regular , 25pt
Subheading – Hoefler Text Black,14pt,TT
Body – Hoefler Text Black, 12pt

This project examines the evolution of protective body armor from its earliest forms to the advanced systems used today. It explores how changes in materials, design, and engineering have shaped the development of armor in response to evolving weapons, warfare tactics, and safety needs. By analyzing historical examples alongside modern technological innovations, the study traces how body armor has adapted over time to provide greater protection while balancing mobility, weight, and practicality.

COLOR STUDIES



#676f52
C – 58
M – 42
Y – 71
K – 22

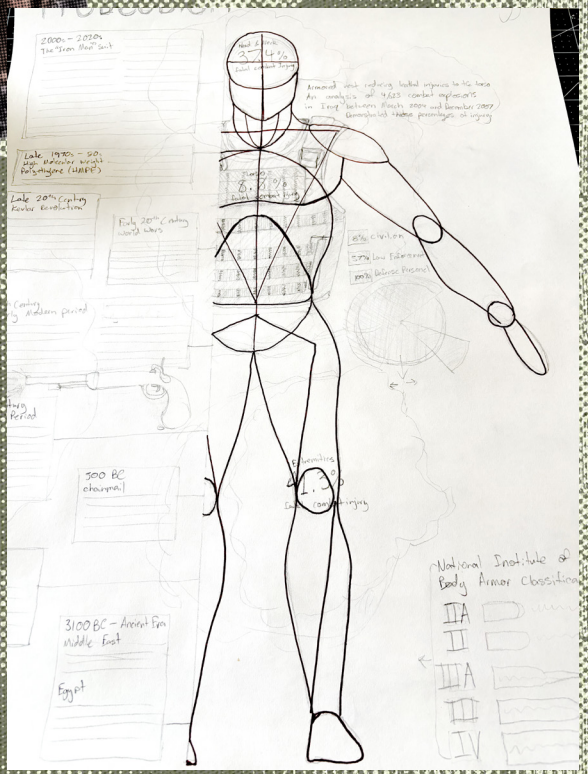
#3158a0
C – 90
M – 73
Y – 6
K – 0

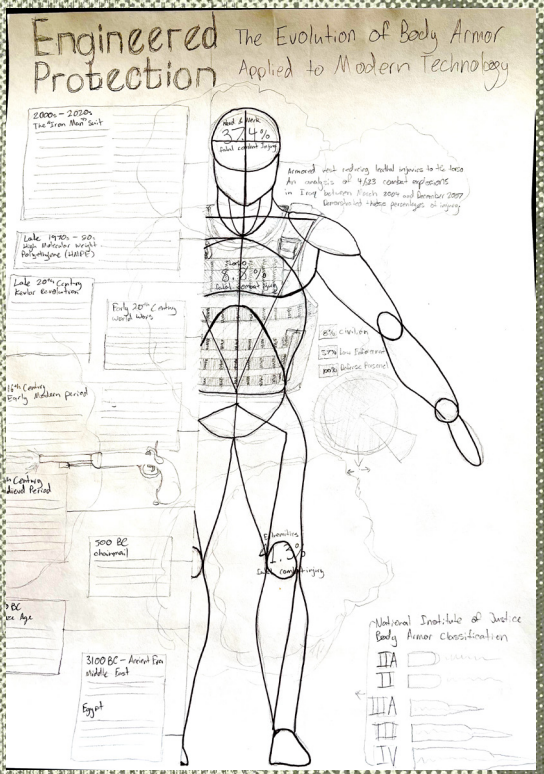
#f15a25
C – 0
M – 80
Y – 98
K – 0

#000000
C – 0
M – 0
Y – 0
K – 100

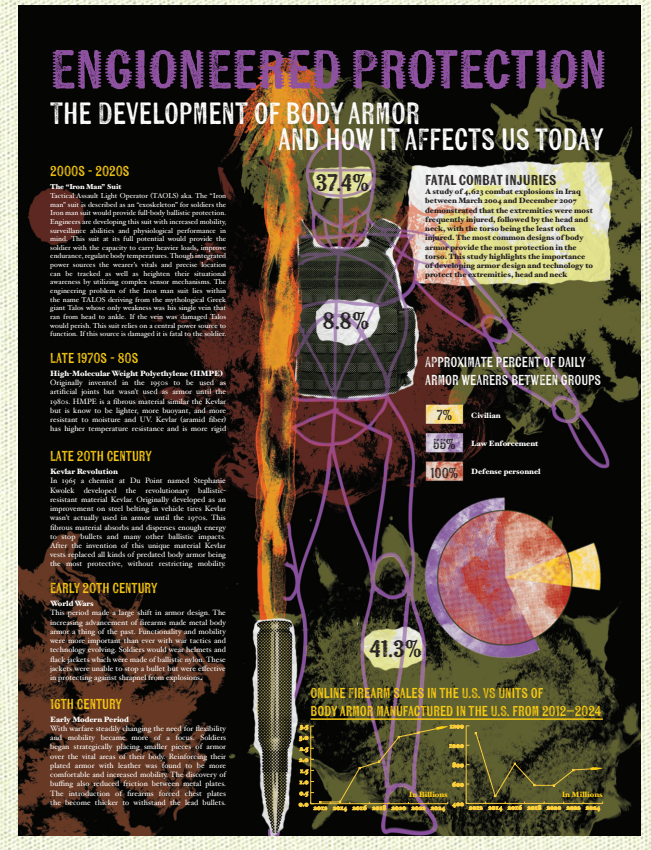


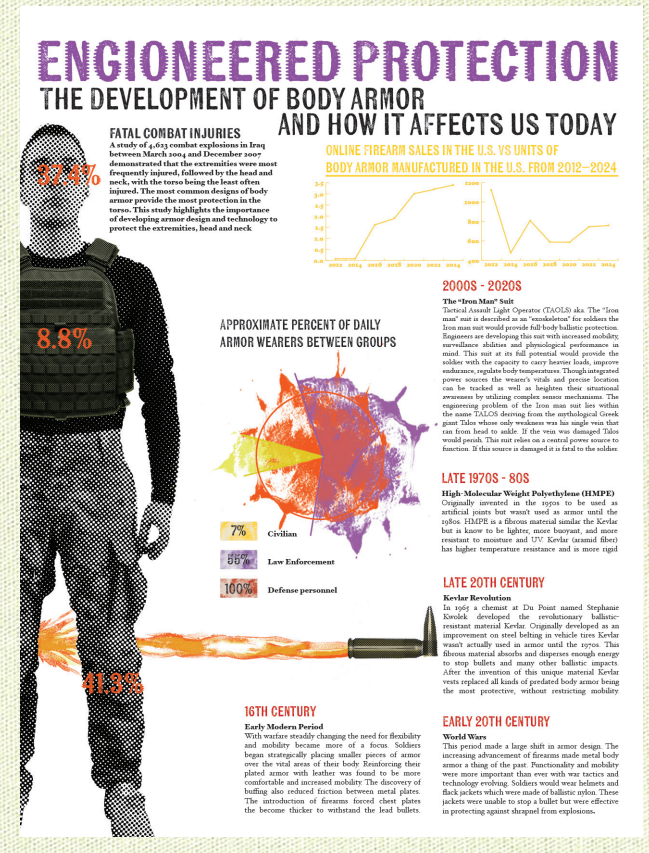
INITIAL SKETCHES





POSTER ROUND 1 & 2

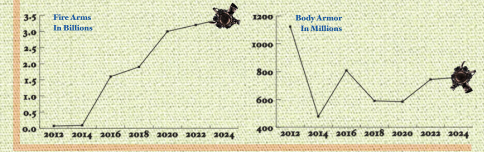




FINAL ROUND

ENGINEERED PROTECTION

TRACING THE EVOLUTION OF BODY ARMOR AND ITS IMPACT ON MODERN SAFETY.



ONLINE FIREARM SALES IN THE U.S.VS UNITS OF BODY ARMOR MANUFACTURED IN THE U.S. FROM 2012-2024

EVOLUTION

2000S - 2020S
THE "IRON MAN" SUIT

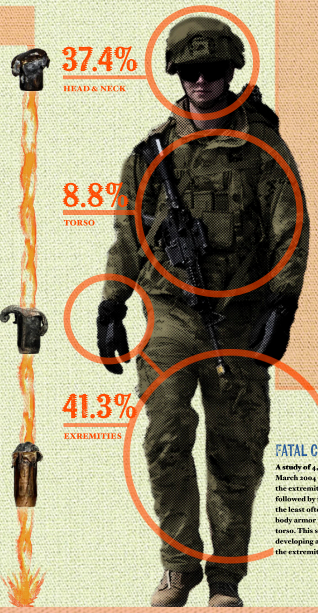
Tactical Assault Light Operator (TALOS) aka. The "Iron man" suit is described as an "exoskeletos" for soldiers the Iron man suit would provide full body ballistic protection. Engineers are developing this suit with increased mobility, surveillance abilities and physiological performance in mind. This suit at its full potential would provide the soldier with the capacity to carry heavier loads, improve endurance, regulate body temperatures. Though integrated power sources the wearer's vitals and precise location can be tracked as well as heighten their situational awareness by utilizing complex sensor mechanisms. The engineering problem of the Iron man suit lies within the name TALOS deriving from the mythological Greek giant Talos whose only weakness was his single vein that ran from head to ankle. If the vein was damaged Talos would perish. This suit relies on a central power source to function. If this source is damaged it is fatal to the soldier.

LATE 1970S - 80S
HIGH-MOLECULAR WEIGHT POLYETHYLENE (HMPE)

Originally invented in the 1950s to be used as artificial joints but wasn't used as armor until the 1980s. HMPE is a fibrous material similar the Kevlar but is know to be lighter, more buoyant, and more resistant to moisture and UV. Kevlar (aramid fiber) has higher temperature resistance and is more rigid

LATE 20TH CENTURY
KEVLAR REVOLUTION

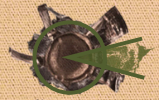
In 1965 a chemist at Du Point named Stephanie Kwolek developed the revolutionary ballistic-resistant material Kevlar. Originally developed as an improvement on steel belting in vehicle tires Kevlar wasn't actually used in armor until the 1970s. This fibrous material absorbs and dispreses enough energy to stop bullets and many other ballistic impacts. After the invention of this unique material Kevlar vests replaced all kinds of predated body armor being the most protective, without restricting mobility.



APPROXIMATE PERCENT OF DAILY ARMOR WEARERS BETWEEN GROUPS


100%
DEFENSE PERSONNEL


55%
LAW ENFORCEMENT


7%
CIVILIANS

FATAL COMBAT INJURIES

A study of 4,653 combat explosions in Iraq between March 2004 and December 2007 demonstrated that the extremities were most frequently injured, followed by the head and neck, with the torso being the least often injured. The most common designs of body armor provide the most protection in the torso. This study highlights the importance of developing armor design and technology to protect the extremities, head and neck.

Prototype DESIGN PROCESS 2

INTERACTIVE & EXHIBITION DESIGN



OBJECTIVE

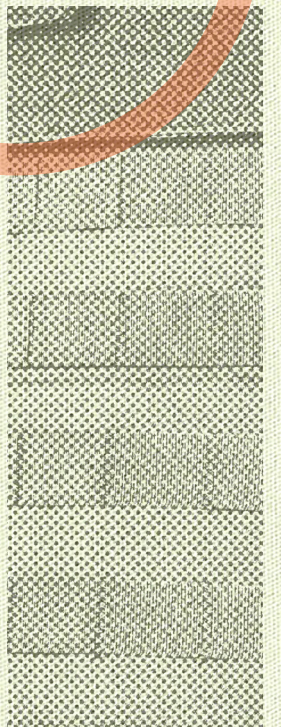
Medium

Information Design

Data Visualization

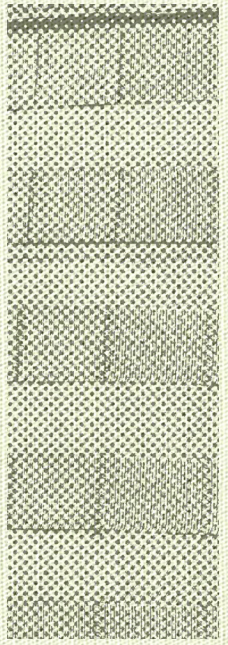
Motion Graphics

audio + visual storytelling



The objective of this prototype is to illustrate the history of body armor in more detail. This deliverable will show the progress of body armor engineering from ancient eras to modern day. Through images and text moving and sequenced in time my audience will have a clear visual and intellectual idea of the history of body armor and what the protection of humanity looks like today.

PROJECT DETAILS



Scale

I plan to make one video with a time range of 1 minute and 30 seconds. This time range will provide the audience with ample time to read the text and analyze the images.

Scope

The scope of this project is to highlight the history of body armor as well as the materials used to make the armor.

Materials & Technology

Adobe After Effects for the motion graphics and video

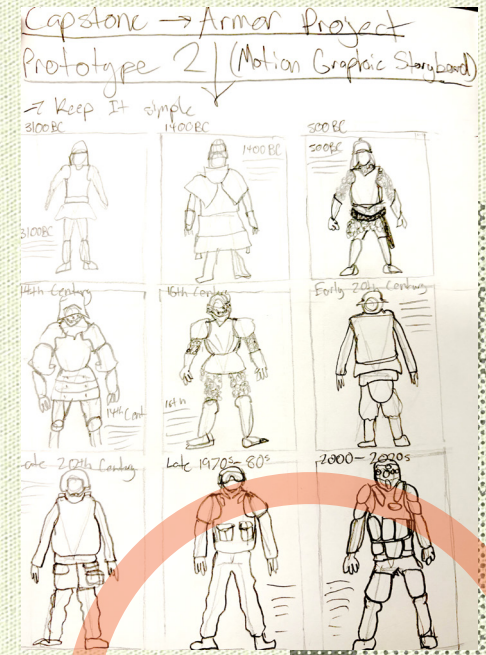
Adobe Photoshop for editing, sizing and exporting images

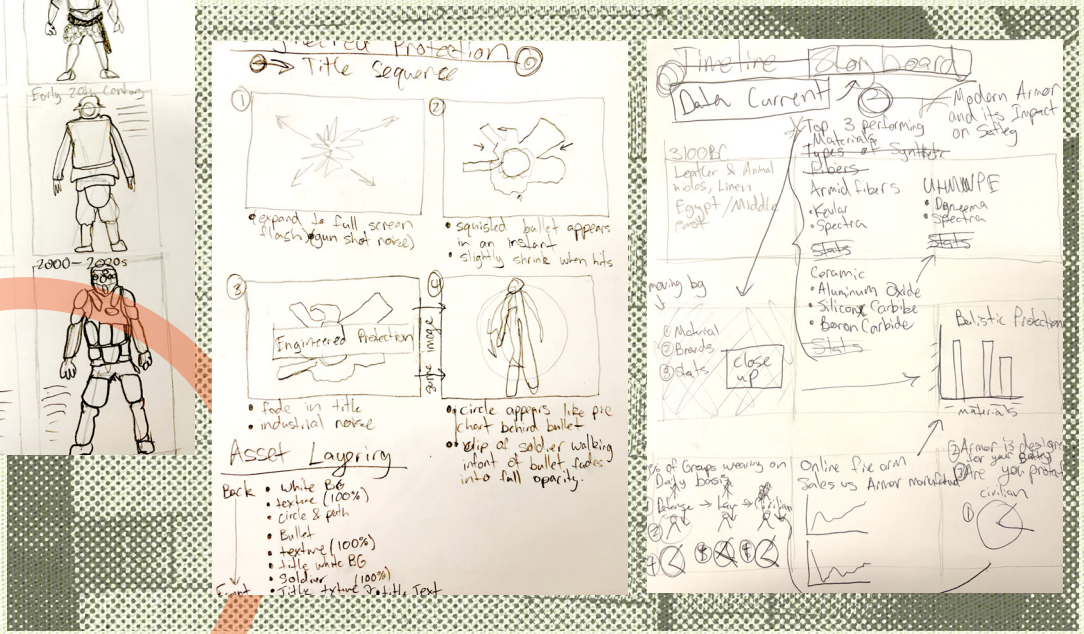
Pixibay.com for music

Course of Action

Story board intro and content on paper
Gather images and text needed for animation
Photoshop images and place text into After Effects
Drop images into After Effects and place them into their section of time
Place music and stitch together to fit into
Lay out each frame according to final properties of animation.
Key frame final properties and animate.

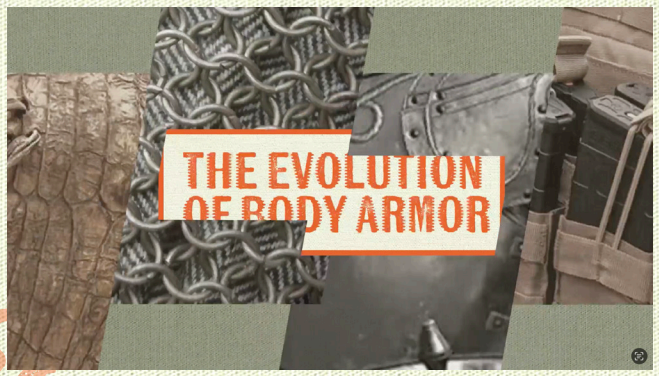
STORYBOARD SKETCHES





VIDEO FRAMES







4



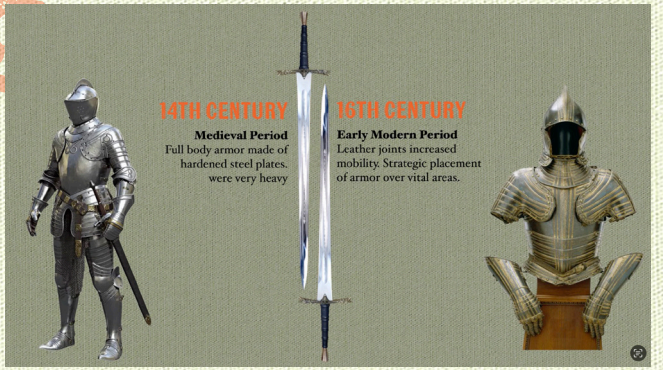
1400 BC

Bronze Age
Bronze plate armor was introduced in Greece.

500 BC

Chainmail
Introduced by the Celtics and adopted by the Romans

5



14TH CENTURY

Medieval Period
Full body armor made of hardened steel plates. were very heavy

16TH CENTURY

Early Modern Period
Leather joints increased mobility. Strategic placement of armor over vital areas.

6



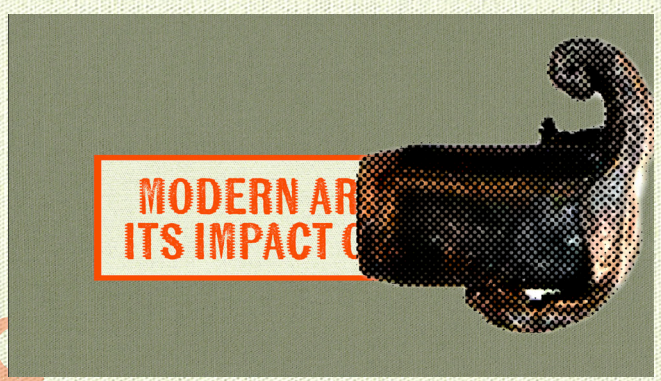
EARLY 20TH CENTURY

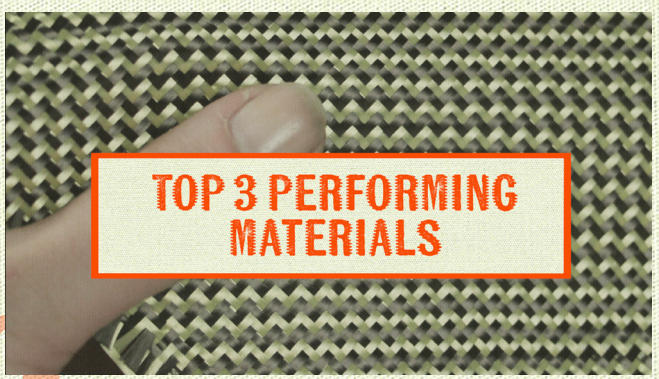
World Wars
Firearms highlighted the importance of mobility. Soldiers wore flack jackets made of ballistic nylon.

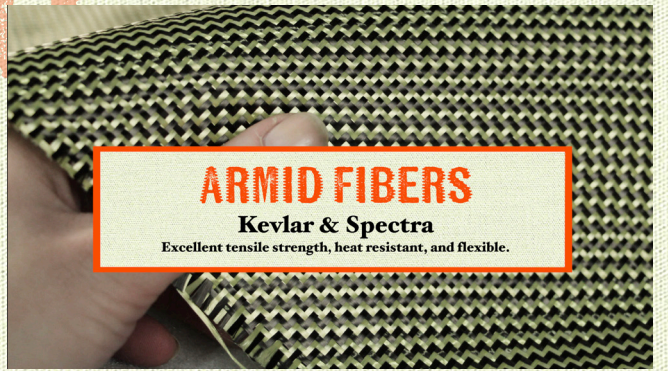
LATE 20TH CENTURY

Kevlar Revolution
Kevlar was invented in 1965 and is still one of the most effective balistic resistant materials today.


2013-2019
The "Iron Man" Suit
Tactical Assault Light Operator (TALOS) relied on a central power source to function and was fatal to the soldier if damaged. Discontinued in 2019
CURRENT
Synthetic Fibers
Focused on high strenght to weight ratio, mobility, and tempurature regulation. Modern armor has adjustable fitting and stricter testing protocols.


MODERN AR
ITS IMPACT


TOP 3 PERFORMING MATERIALS



VIDEO LINK

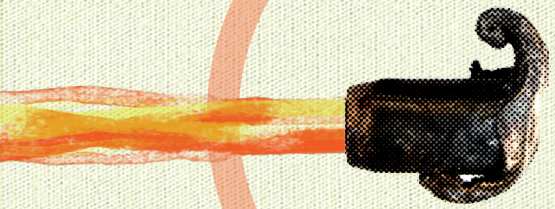
https://vimeo.com/manage/videos/1188540444



FINAL CREDITS



GRPH 497 - CAPSTONE RESEARCH PROJECT



by Seth Fleshman

Music – Pixibay.com
Images – found and manipulated in Photoshop
Illustration – Scanned ink and water on paper

