DESERT NOMAD

Dust Storm Protection Collection

MC SMITH

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COLLECTION OVERVIEW

In a world altered by global warming, many cities have fallen due to desertification. This collection of garments, outerwear, and equipment will be made from sustainable natural fibers, and provide protection from dust storms, for a newly nomadic civilization to survive as they travel the desert at night in search for resources.

HISTORY OF GLOBAL WARMING AND CLIMATE CHANGE

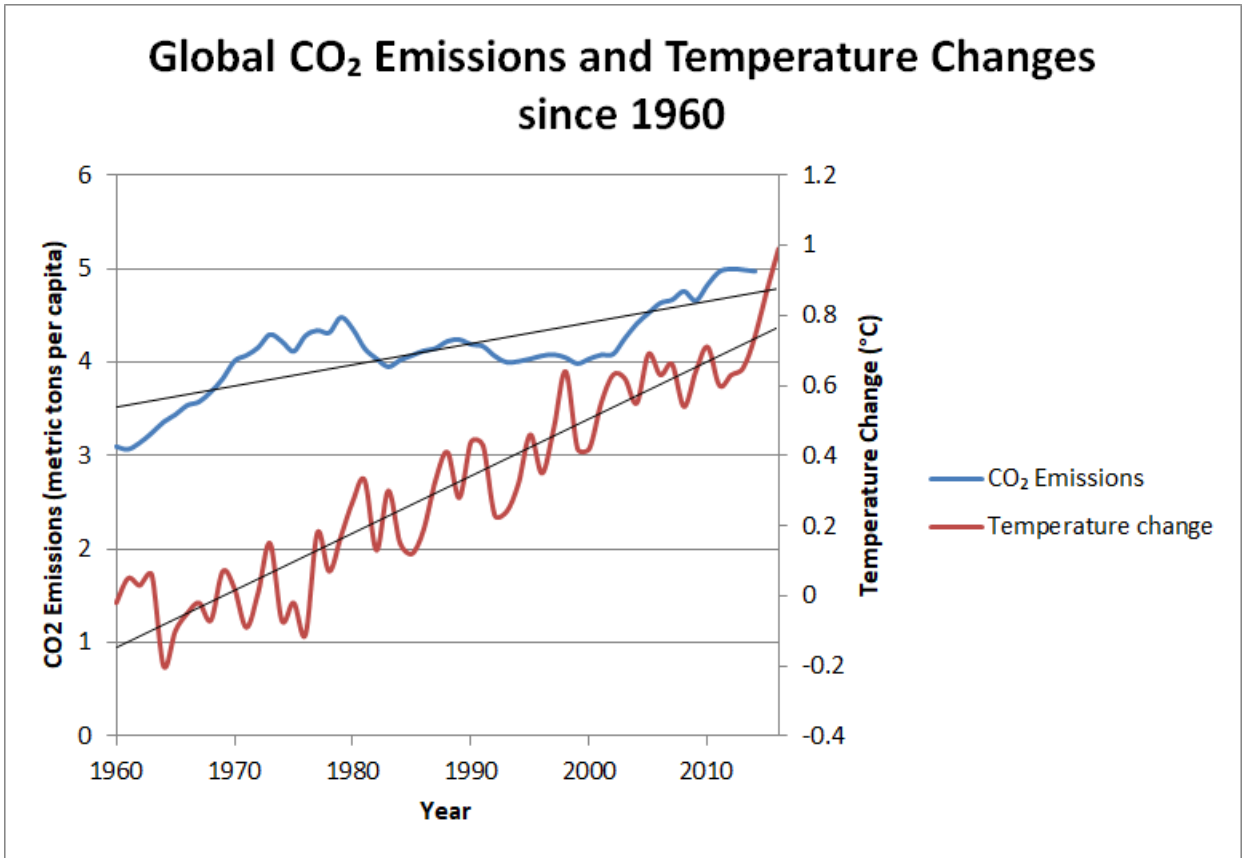
The ancient Greeks thought that humans could change temperatures and influence rainfall by chopping down trees, plowing fields, or irrigating a desert (Betancourt, 1976). Although their actions were harmless at the time, they understood the impact that humans could have on the atmosphere even in ancient times. Though climate change has been a concept since ancient times it has never been widely accepted, by the public, as a threat. What will the world look like when climate change escalates, and human inaction persists?

There are many theories on the journey to the wide-spread validation of climate change. One theory was believed until the Dust Bowl of the 1930s was that "rain follows the plow" (History.com Editors, 2017). The idea that tilling soil and other agricultural processes could result in increased rainfall was just the start of recognition of climate alteration (History.com Editors, 2017). Although this theory is disproved, it is one of many that came before and after an important discovery. The Greenhouse effect was first investigated in 1820 by Joseph Fourier, a French mathematician and physicist (History.com Editors, 2017). He said that energy reaching the planet as sunlight must be balanced by energy returning to space because heated surfaces emit radiation (History.com Editors, 2017). This oversimplification introduced the concept of energy staying within the Earth's atmosphere and not returning to space, which would ultimately warm the Earth. Later in 1860, John Tydall, and Irish scientist, procured data that showed coal gas containing carbon dioxide, methane, and volatile hydrocarbons was effective at absorbing energy (History.com Editors, 2017). The carbon dioxide was able to absorb multiple wavelengths of sunlight (History.com Editors, 2017).

Not only were scientists interested in how gases were warming the earth, but they were also curious about how less gas could potentially cool it. In 1895, Swedish chemist, Suante Arrhenius collected data that showed that if carbon dioxide levels were halved, global temp could decrease by about 5 degrees Celsius (History.com Editors, 2017). This led him to question climate if the carbon dioxide levels increased by 100% (History.com Editors, 2017). Doubling the carbon dioxide levels would imply an increase in the global temperature (History.com Editors, 2017). It is baffling to understand that the correlation between carbon dioxide in the atmosphere and global temperature was recognized by scientists in 1895 but still remains unacknowledged from policy makers today in 2020.

By the 1930s, British engineer, Guy Stewart Callendar noticed a significant increase in temperature in the North Atlantic Region (History.com Editors, 2017). Despite skeptics, he became a huge advocate for greenhouse effect warming keeping climate change at the forefront, inspiring new organizations and movements (History.com Editors, 2017). His actions led to the first government funded projects to monitor global warming and carbon dioxide levels (History.com Editors, 2017). One of these projects being in 1958, Scripps Institution of

Oceanography funded a research project in Hawaii's Mauna Loa observatory. Scripps geochemist Charles Keeling recorded carbon dioxide data that revealed the "Keeling Curve" (History.com Editors, 2017). The data portrayed "upward, saw tooth-shaped curve showing a steady rise in CO2 levels, along with short, jagged up-and-down levels of the gas produced by repeated wintering and greening of the Northern Hemisphere (History.com Editors, 2017)." It would be later that computer modeling would make it possible to predict outcomes of the rise of carbon dioxide. It showed that the doubling of carbon dioxide produced warming of 2 degrees Celsius within the next century (History.com Editors, 2017).



Above is a graph demonstrating changes in carbon dioxide emissions and global temperature using data taken from NASA and The World Bank (Driskill, 2017).

Climate change was not seen as a pressing matter at this point of history given the timeline of theorized danger. In fact, in the 70s some scientists thought that pollution could block sunlight and cool the earth down (History.com Editors, 2017). There had bad some data that suggested the Earth was cooling from 1940 – 1970 due to a boom of aerosol pollutants that were said to reflect heat from the sun (History.com Editors, 2017). But in 1988, a sudden increase in global temperature occurred with the hottest summer on record, as well as an increase of drought and wildfires in the United States (History.com Editors, 2017).

The data was becoming impossible to ignore. In a presentation to Congress on June 1988, NASA scientist James Hansen presented models to Congress and testified that he was, "99% sure that global warming was occurring" (History.com Editors, 2017).

This spurred governmental action. In 1989, the Intergovernmental Panel on Climate change was created (History.com Editors, 2017). It was established under the United Nations to provide a scientific view of climate change and its' political and economic impacts. Research found that severe heat waves, droughts, and more powerful hurricanes were inevitable if the global temperature continued to rise (History.com Editors, 2017). They also found that massive glaciers at the poles were melting at high rates which would cause sea levels to rise between 11 and 38 inches by 2100 (History.com Editors, 2017). This increase would cause enough flooding to swamp many coastal cities. In 1997, the Kyoto Protocol was created (History.com Editors, 2017). It was the first global agreement to reduce Greenhouse Gases, finally attempting to hold countries accountable for their carbon emissions. This protocol sought to reduce emission of six Greenhouse Gases in 41 countries plus the European Union to 5.2% below the 1990 levels during the target period of 2008 to 2012 (History.com, Editors). This Protocol was signed by Bill Clinton upon conception, however in March of 2001, George W. Bush denied the Kyoto Protocol stating it was "'Fatally flawed in fundamental ways and that the deal would hurt the U.S. economy (History.com Editors, 2017)." Perhaps the most passionate efforts by a politician to spread environmental awareness occurred in 2006. Former Vice President and Presidential candidate Al Gore debuted his film an *Inconvenient Truth*. Gore received the Nobel Peace Prize in 2007 because of his work on climate change (History.com Editors, 2017). Although there seemed to be an influx of evidence, there were still skeptics consistently calling the IPCC predictions and Gore's film over exaggeration (History.com Editors, 2017). The shocking reality is that these skeptics included the policy makers that affect all of our lives. On November 6, 2012 Trump tweeted, "the concept of Global Warming was created by and for the Chinese in order to make U.S. manufacturing noncompetitive" (History.com Editors, 2017). Later when Trump would become President in 2016, he would not only continue to deny climate change, but also take action to further prolong our journey to green living.

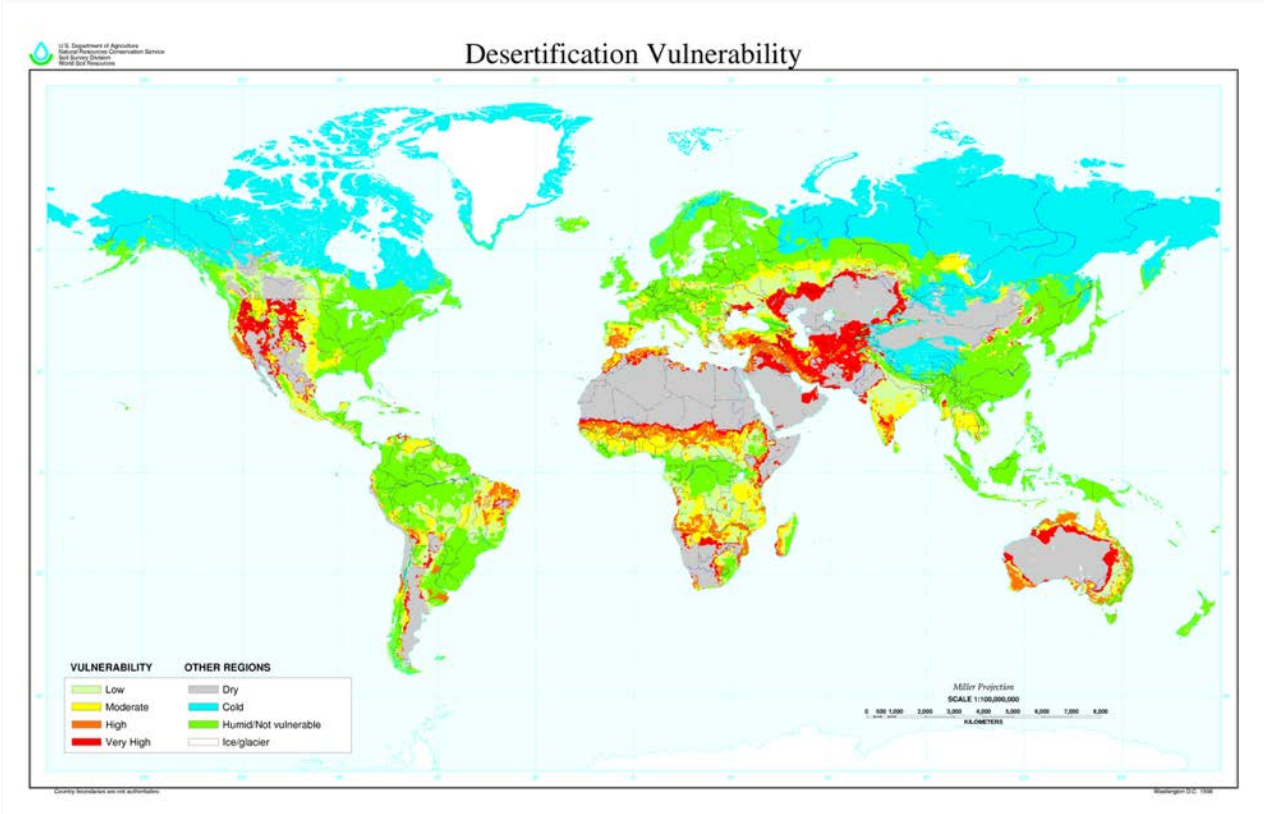
Policy makers that deny the science behind climate change can no longer make such comments unscathed. In August 2018, Swedish teenager and climate activist Greta Thunberg created a movement for climate change that could not be ignored (History.com Editors, 2017). She began protesting in front of Swedish Parliament with a sign that read "School Strike for Climate" (History.com Editors, 2017). By November of the same year over 17,000 students in 24 countries were striking for climate change and demanding action from their governments (History.com Editors, 2017). This movement, and others like it, have brought climate change to the forefront of human action. Now more than ever, climate change has become a priority to the millennials and the generations after them.

If human inaction persists and the earth warms to 2 degrees Celsius we will face more extreme weather cycles and devastating consequences (Mann, 2014). One of these consequences is desertification of arid regions all over the world, decreasing the amount of fertile land (Mann, 2014).

DESERTIFICATION

While young people began to take action all over the world it seemed the threats of climate change on civilization was were already rampant. A natural outcome of the human actions causing an acceleration of global warming is an acceleration of desertification (Nunez, 2019). Desertification is a process by which fertile land becomes desert, as a result of drought,

or deforestation (Desertification, 2019). Climate change has been noted to amplify these effects. One study concluded that if the Mediterranean region were to experience a warming of 2 degrees Celsius all of southern Spain would become a desert (Nunez, 2019). Another study found that with the same level of warming would result in aridification, of up to 30 percent of the Earth's land surface (Nunez, 2019). As climate change is exacerbated, desertification progresses rapidly due to the escalation of elements like drought and forest fires (Nunez, 2019). The smoke and carbon released into the atmosphere from these fires is also causing an acceleration of atmospheric warming (Nunez, 2019). In addition to forest fires, desertification is a threat to our current western ecosystems (nsf.gov, 2020). The loss of fertility in the soil is mainly due to salinization, erosion, and careless farming practices (nsf.gov, 2020). Desertification can also be caused by population growth which prompts increased wood harvesting, illegal farming, and land-clearing for housing (Nunez, 2019).



U.S. Department of Agriculture map from 1998 showing global desertification vulnerability (Reich, 2003)

Regions with arid and semi-arid climate are especially threatened by climate change because of their vulnerability to desertification (Verstraete, 1991). Due to climatic changes caused by greenhouse warming, drier continental interiors may amplify local or regional climate changes (Verstraete, 1991). In the United States, regions with a cold semi-arid climate include upper western states (Idaho to Dakotas) to warm desert and semi-arid climates in southwestern states (Nunez, 2019). Low rainfall drylands account for more than 40 percent of the world's terrestrial surface area and are ever expanding due to human caused land degradation (Nunez, 2019). According to European Commission's World Atlas of Desertification, 75% of Earth's land area is already degraded, and more than 90% could become degraded by 2050 (Nunez,

2019). The commission's Joint Research Centre also found that 1.61 million square miles is degraded annually (half of the size of the European Union), with Africa and Asia being the most affected areas (Nunez, 2019). When land becomes desert, its' ability to support human, animal, and plant life declines. This can cause many problems for humans ranging from malnutrition, respiratory disease caused by dusty air, and other diseases caused by lack of clean, accessible water (Nunez, 2019).

DESERT DUST

Global warming has caused an increase in dust storms in arid and semi-arid regions. These include high winds and worsening air quality due to an increase in particulates in the air (Fact sheets - Dust storms, 2003). Dust storms are common and unpredictable making it difficult to prepare in a timely fashion (Fact sheets - Dust storms, 2003). Deserts receive less than 10 inches of rainfall per year making water sources and vegetation scarce (Fact sheets - Dust storms, 2003). There is little to no foliage for shelter or food source (Fact sheets - Dust storms, 2003). Inhaling sand or dust can cause severe respiratory irritation (Fact sheets - Dust storms, 2003). Prolonged exposure to airborne dust can lead to chronic breathing and lung problems, and possibly heart disease (Fact sheets - Dust storms, 2003). Dust storms are also disorienting. If no effort is made to maintain sense of direction harsh winds and dust make it impossible navigate. Sometimes dust becomes so thick one can't see further than 3 meters (Fact sheets - Dust storms, 2003). If humans don't take action on climate change, the interior regions of the United States as well as other regions around the world will face the desertification of civilization (Nunez, 2019).

The Dust Bowl was on obvious environment to investigate when learning about how dust effects civilization in the United States. The Dust Bowl is an iconic period of time in the 1930s when droughts degraded the soil of the southern plains region of the United States (History.com Editors, 2009). From Texas to Nebraska people and livestock were killed and crops failed due to high winds and suffocating dust (History.com Editors, 2009). Dust storms were referred to as "Black Blizzards," as clouds of dust would darken the sky for sometimes days at a time (History.com Editors, 2009). Dust would penetrate homes, even when sealed, leaving a coat of dust on food, skin, and furniture (History.com Editors, 2009). Many developed "dust pneumonia" and experienced chest pain as well as difficulty breathing (History.com Editors, 2009). Estimates demonstrate that dust respiration posed a significant threat as a range of hundreds to several thousand deaths were attributed to it (History.com Editors, 2009). To protect themselves from the dust, people would fashion woven fabric around their face (rag or bandana) to avoid respirating dust, as well as wearing goggles to protect their eyes (History.com Editors, 2009). As land continues to degrade and desertification sets in the interior United States faces a threat even larger than the Dust Bowl (History.com Editors, 2009). Dust is one of the number one problems we must account for.

DESERT NOMAD

User

As desertification evolves, major cities have become a hub for resources and small towns have been destroyed by the elements. With fossil fuels running low, foot travel has become

essential. As such the desert Nomad has emerged. In the newly desert lands, people have learned efficient adaptations to protect themselves from desert elements. These Nomads are 20-40 years old who are relied upon by the rest of their community to provide resources for it.

Rules

Nomads must prepare methods of visibility to navigate the desert at night and identify night desert creatures whether they be threat or food source. Desert Nomads walk through the desert for multiple nights consecutively to locate necessary resources. They must always be prepared for the unpredictability of intense dust storms as the travel the desert without the shelter of vegetation. Nomads only travel with what they are wearing and the gear on their backs. They rest during the day for their night travels and must carry light gear to maintain optimal mobility. The desert nomads don't flee as lands turn more infertile and dust storms increase in severity. Instead, they adapt. Rooted in the lands they watched dry up, the desert nomad collects resources and tries to revitalize the lands around them. They go to work in the small towns of remaining peoples and they continue to try to live their lives as they make creative efforts to rejuvenate he land around them. These efforts include establishing seed banks, reintroducing species, countering erosion through terracing, enriching soil with nutrients, and planting trees. Enable to spends long periods of time outside searching for viable lands and vegetation Desert Nomads must be prepared for the harsh elements inflicted upon them in their changed lands.

Environment

Within the Drylands, arid regions have expanded due to the effects of climate change. The desert expansion has caused people to leave what were once livable cities for other places with fertile lands that can better support life. Due to the escalation of sandstorms, drought, and storms the ground has become infertile. The now dry lands have caused a shortage of food and water sources forcing people with agency to leave in search for more sustainable lands. However, some people didn't have enough resources to leave, and others are loyal to their lands. These are the people who stayed. These are the Desert Nomads. The most important environmental factor nomads will need to account for is the unpredictable dust storms that can occur at least once a week (Fact sheets - Dust storms, 2003). With a lack of vegetation, there is nothing to shelter behind for protection from the harsh winds and particles in the air. When Nomads are expending energy, they are surrounded by darkness as well as cold temperatures.

Success

To the Nomads, success will mean the ability to walk the desert and find valuable resources for survival despite the dust storms and the physiological challenges they face. Some Nomads return to a permanent shelter after their excursions for resources, some however have adapted a permanently nomadic lifestyle. They must be able to survive unpredictable weather conditions, with limited resources.

ATHLETE NEEDS

Dust Storm Protection

When it comes to problems to solve for within this desert collection, the focus will be on dust storms and how to protect my athlete from the high winds and suffocating dust. A Dust storm is when strong winds pass over dry loose sand or soil and lifts the particles from the surface of the land (Gross, 2018). It will be important to investigate ways to protect the Desert Nomad from the unpredictability of dust and winds as they walk the desert at night. As a dust storm approaches, Nomads have very little time to find shelter as well as brace for the storm. It is essential that Nomads have outerwear, apparel, and equipment to break harsh winds and protect them from exposure to dust.

Navigation

Navigation is another aspect of finding resources while traveling at night. I will need to investigate different ways of navigating the desert will low visibility. Traveling at night is a common way of approaching desert commuting. During the day, the harsh heat and sun make walking the desert inefficient for the Nomads body. Expending energy during the day could cause perspiration and lead to dehydration as well as deplete your caloric intake (DNews, 2011). Poor insulation or evaporation (due to wet clothes) can cause your temperature to drop rapidly as the sun goes down (DNews, 2011). It is important that Desert Nomads have a way of navigating the desert at night to find resources as well as shelter.

PHYSIOLOGICAL NEEDS

Respiration Protection

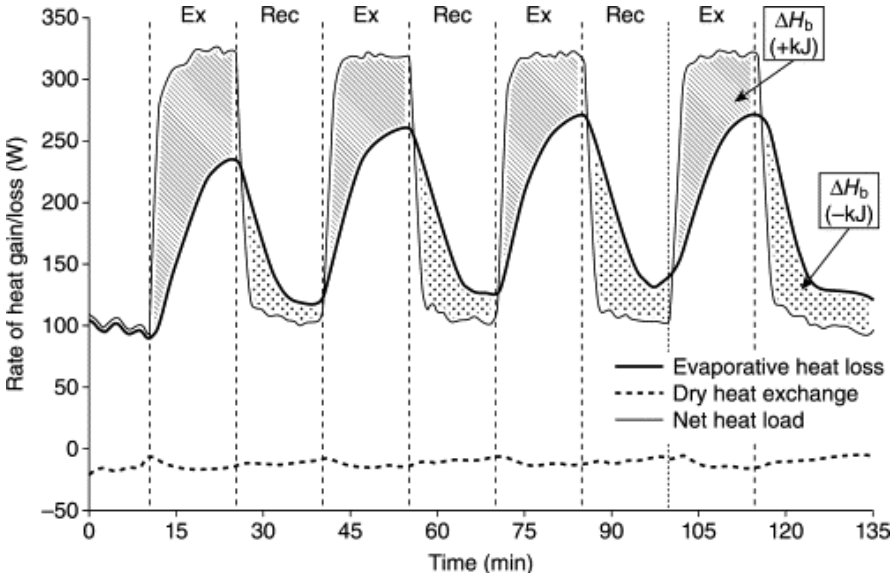
Respirating dust and soil can create long term heart and respiratory problems and well as immediate irritation (Gross, 2018). Dust particles can be smaller than 2.5 microns in diameter and able to enter the bloodstream carrying things like bacteria, virus, fungi, pollutants, and allergens (Gross, 2018). Dust can also damage your eyes if exposed causing irritation and blindness (Gross, 2018). It is important that Desert Nomads cover their mouth, nose, and eyes during a dust storm.

Dehydration

It is important that the Desert Nomad travels at night because of inefficiency of traveling during the day (DNews., 2011). Harsh sun and dry heat pose a threat of perspiration to cool the skin which can lead to dehydration (Deserts, 2020). Traveling at night when the sun is down and the temperatures drop will allow for more comfortable travel (DNews., 2011). On average deserts get less than ten inches of precipitation each year (Deserts, 2020). The lack of water makes dehydration a prominent threat to living things in the desert (Deserts, 2020). Climate change is also reducing snowpacks as well as melting glaciers that provide freshwater to desert ecosystems (Deserts, 2020).

Thermoregulation

As the sun goes down, Desert Nomads prepare to travel for resources. The transition of day and night in the desert includes a rapid temperature drop (Deserts, 2020). Night temperatures range from -2 and 4 degrees C making it essential to have a thermoregulating system that is both insulating but breathable as the athlete walks through the night (www.nps.gov, 2020). Nomads must utilize insulating materials that are also breathable to allow for evaporation of water vapor as Nomad experiences metabolic heat production (Kenny, Flouris, 2014).



Rates of heat gain and heat loss during a baseline rest period and an intermittent exercise (Ex) bout performed in the heat. The shaded area between the rate of heat gain (metabolic + dry heat exchange) and evaporative heat loss represents the change in body heat content (Kenny, 2014)

According to __ approximately 70 – 95% of energy (depending on task) is released as heat energy (Kenny, 2014). This heat must be dissipated to avoid hyperthermia, therefore breathable garments are very important to allow for evaporation and postpone perspiration (Kenny, 2014).

MARKET SIZE

Although the collection will exist in the far future where markets and industry might not resemble the systems that we have today, the commuter industry supports the mobile lifestyle that my user will experience. This collection identifies as commuter wear because of the constant travel that searching for resources requires. Global Smart Commute Market is expected to grow from 26.52 USD in 2017 to 104.22 billion USD by 2023 (marketresearchfuture.com, 2018). Desert Nomads rest in the day and travel at night making commuting an essential part of their lifestyle.

PRODUCT OPPORTUNITY

Overall, there is a noticeable gap in the market when it came to dust storm protection garments, outerwear, and equipment. There are very few products I could find that were designed specifically for dust storm conditions and considered problems specific to night desert traversing. There was also a lack of modern performing garments that are made from naturally derived materials such as linen, or cotton. It is important to use natural materials to minimize the products environmental impact and prevent further climate alterations. Focusing on original American workwear demonstrated the timeless silhouettes and materials and what makes them so functional. Although technology continues to evolve, it will never erase the enduring reliability of natural materials such as cotton, linen, and wool. Enable to live in a world damaged by human inaction and poisonous materials, the Desert Nomad Collection must reflect sustainable practices. By using natural materials, sustainability will be considered as it should be in every product.

COMPETITOR ANALYSIS

Natural Fibers in Vintage Workwear

When approaching garments on the market that are designed for desert ecosystems and made of natural materials, classic American workwear demonstrated how natural fibers were utilized to accommodate human physiology and performance. Before synthetic materials became mainstream in sports product apparel athletes were performing in clothes made of cotton, wool, and linen (MasterClass, 2020). American workwear faced a range of temperatures, and abrasion while being worn by its' user however it was not always optimized for the job to be done (MasterClass, 2020). To this day these classic americana workwear silhouettes and materials are utilized for both function and heritage aesthetic.

Natural Fiber Outerwear

a)

b)

c)

d)

Figures	Brand	Garment	Fiber	Construction	Finish
a	Pendleton	Heston Wool Coat	100% Virgin Wool	Woven	N/A
b	Dickies	Long Sleeve Coveralls	100% Cotton	6 oz Twill	N/A
c	Carhartt	Duck Bib Overall	100% Cotton	12 oz Duck Canvas	N/A
d	Wrangler	Sherpa Lined Denim Jacket	100% Cotton	Woven Denim	N/A

When investigating natural fiber outerwear explored vintage American workwear and how workers were layering their outfits. The outerwear provided a multitude of silhouettes including Shirt Jacket, Insulated Jacket, Bibs, and Coveralls. These outerwear options were meant to protect the wearer from the cold as well as elements that appeared on jobsite (MasterClass, 2020). These options were made of tightly woven Cotton or Wool for increased durability and protection (Little, 2016). Wool, or Cotton insulation was added to woven garments to keep body head close to the wearer (MasterClass, 2020). Silhouettes were often oversized to allow for layer below for colder weather (Little, 2016).

Natural Fiber Garments

e)

f)

g)

h)

Figure	Brand	Garment	Fiber	Construction	Finish
e	Ralph Lauren	CPO Inspired Herringbone Linen Shirt	77% Cotton, 23% Linen	Woven, Herringbone	N/A
f	Wrangler	Carpenter Jeans	100% Cotton	Woven, Denim	N/A
g	Carhartt	Original Fit Firm-Hand Pant	100% Cotton	Woven, 12 oz Duck Canvas	N/A
h	Wuhou	2 pc Thermal Long Johns	100% Cotton	Knit, waffle	N/A

The garments selected exist in the market and are inspired by heritage garments that workers wore performing their jobs. They have little mobility accommodation as well as adjustability but the materials they are made of provide protection, thermoregulation, and durability. Cotton and Linen provide breathability for the athlete as their body temperature rises

during metabolic heat production (MasterClass, 2020). Waffle knit allows for more air to get trapped between the fabric and user for better breathability and insulation (Little, 2016). Garments are tightly woven with cotton yarns to increase durability (MasterClass, 2020). Finally, silhouettes are fitted but roomy to allow for greater range of motion (Little, 2016).

Natural Fiber Equipment

i)

j)

a)

j)

Figure	Brand	Garment	Fiber	Construction	Finish
i	High on Leather	Leather Backpack	100% Goat Leather	N/A	N/A
j	Serbag	Large Surplus Hiking Backpack	100% Cotton, Leather accents	Woven, Canvas	N/A
k	Fjallraven	Kanken Re-Wool Laptop 15”	Organic Recycled Traceable Wool	Woven	N/A
l	Wuhou	Sunsomen	100% Cotton lined, Leather	Woven, Canvas	DWR

Backpacks on the market that are made for backpacking long treks are made of mostly synthetic materials, however some bags that were more heritage inspired utilized natural

materials. Lots of bags utilize leather for its durability, longevity and flexibility (MasterClass, 2020). As the leather gets used the flexibility increases, however its' durability is lasting (MasterClass, 2020). Military bags were also made of Cotton canvas and included notions made of metal and leather (Little, 2016). These bags were often geometric in silhouette offering little weight distribution aid (Little, 2016). External and internal compartments are present for organization of gear and increased accessibility.

Tent Exploration

m)

n)

o)

p)

Figure	Brand	Garment	Fiber	Construction	Finish
m	Danchel	4-Season Roomy Bell Yurt	100% Cotton	285GSM Cotton Canvas	DWR
n	The North Face	Homestead Roomy 2 Tent	75D polyester taffeta	Woven plain flat weave	PU Coating
o	Explopur	Automatic Tent – Instant Unfold	Polyester Taffeta	Woven, plain flat weave	N/A
p	Black Diamond	Deluxe Cliff Cabana Double Fly	Nylon	210d Micro Ripstop	DWR

Protection is an important element for this design collection therefore shelter became an obvious avenue to explore. Looking at tents on the market it was important to analyze a variety to gain inspiration from the different mechanisms used to deploy them. Combining apparel with shelter is a task that requires lots of modular and mobility exploration. It was important to gain insight from a variety of tent styles that athletes were utilizing in desert environments. The

mechanisms noted included an instant unfold tent, a suspended tent, an aerodynamic tent, and a traditional canvas tent.

SWOT Analysis

Item	Strengths	Weaknesses	Opportunities	Threats
	*Materials;* Wool is insulating *Silhouette;* Storage pockets *Color;* dark absorbs heat *Performance;* Durable	*Performance;* Lacks mobility, *Silhouette;* Lacks adjustability	More mobility features, more interesting silhouette, modularity, dust protection	Heavy weight materials, no wind resistance
	*Materials;* Durable Canvas woven *Silhouette;* Full body coverage, Elastic waist, *Color;* Dark blue, blends into night *Performance;* Protects full body from abrasion, insulating	*Performance;* Not designed for mobility, lacks breathability *Silhouette;* Small pockets storage	Reinforcement of construction for durability, added mobility, added modularity, dust protection	Not comfortable for a long wear, unable to carry gear
	*Silhouette;* Bib offers coverage, increased storage *Performance;* suspenders adjustability *Materials;* durable fabric	*Manufacturing;* Lacks reinforced construction *Performance;* Lack of mobility	Increased mobility, Increase storage capacity, dust protection	Lack of wind resistance, enough room for pants under?
	*Materials;* Sherpa for insulation, Denim for durability *Silhouette;* Side access pockets *Performance;* warm and long product life	*Materials;* Heavy garment *Silhouette;* Lacks adjustability, bulky *Performance;* lacks mobility	Increased gear storage, better garment closure, increase adjustability	The more material the more weight Nomads carry
	*Materials;* Cotton allows for breathability *Silhouette;* Side entry pockets easy access	*Performance;* Lacks mobility features *Silhouette;* Lacks adjustability *Color;* Lacks stealth	Added mobility and adjustability	Knit is more flexible

	*Materials;* Denim is durable, cotton is breathable *Silhouette;* Allows for movement *Performance;* Abrasion resistant	*Silhouette;* Lack of gear storage *Performance;* No stretch, lack breathability	Increased mobility and wind protection	Heavy for underneath outerwear pant
	*Construction;* Double knee reinforcement for durability *Silhouette;* Utility features	*Performance;* Lack of mobility consideration	Increased modularity	Doubling fabric adds weight and decreases mobility
	*Materials;* Waffle knit for breathability and insulation *Silhouette;* Elastic waist	*Performance;* lacks mobility features	Mobility and modularity consideration	Waffle knit isn't as stretchy as other knits
	*Materials;* Leather is very durable *Silhouette;* external pockets, large silhouette for increased storage	*Materials;* Leather may be too stiff/heavy for mobility	Material choice, shelter integration	Size of backpack should be carefully selected for correct gear storage
	*Silhouette;* Depth of bag allows more storage *Materials;* Leather notions for durability	*Performance;* Weight is allocated to shoulders only	Weight distribution, increase modularity	Bag is too small for shelter integration
	*Materials;* Wool offers durability and soft hand feel, toggle handle	*Silhouette;* Backpack lacks appropriate storage ability	Utilize wool, variety of carrying options	Make sure carrying options are intuitive to avoid confusion
	*Silhouette;* Large bucket storage with flap for ease of access *Materials;* Durable leather body	*Materials;* Leather is heavy for long excursions *Performance;* Straps allocate weight to shoulders	Weight distribution, and material consideration	Even though materials are heavy they can be optimized for different parts of bag

	*Materials;* Canvas shelter allows for breathability *Performance;* protection from elements	*Materials;* Toxic DWR finish	Natural coating (wax) for wind resistance	Dust permeability
	*Materials;* Synthetic materials are very light *Performance;* protect against wind and rain	*Materials;* Synthetic materials pose threat to environment	Natural material application, backpack implementation	Must be intuitive to assemble, multiple features can be confusing
	*Silhouette;* Automatic assembly mechanism, lots of ventilation paneling *Performance;* well vented	*Materials;* Synthetic materials *Silhouette;* can't fully deconstruct	Automatic assembly application to shelter, implement in outerwear/pack	Natural materials may be too heavy depending on size of structure
	*Silhouette;* optimized for mobility as well as suspended deployment	*Performance;* Elevated location not guaranteed *Materials;* synthetic materials	Natural materials, silhouette and mechanism inspiration	Suspension is key in mechanism

DATA COLLECTION

In developing this collection, research methods such as survey, observational study, and quantitative testing will be used to gain external insights for my design solutions. A questionnaire for survivalists and athletes that have participated in high exertion activities in the desert with minimal gear will provide insight from professionals on what products they would utilize in a desert environment, as well as their experiences facing desert conditions. I will conduct an observational Desert Study that will involve an investigation into the desert as an ecosystem and the plants and animals that survive in it. I will understand the survival strategies that they use and contemplate their implementation into products to aid human survival. I also want to do Abrasion Testing to better understand how natural materials will react to high-speed particulates. The collection will have to protect against lots of sand, rock, and wind exposure as well as sealing the athlete from respirating such particles. I could also potentially test the efficacy of naturally derived UV technology that I can apply to my apparel to store heat from the sun during the day to be used at night.

Sand Permeability Test

PHASE OF STUDY	PROCEDURE	DATA COLLECTED	TIMING
Preparation	Buy/Rent Sand Blaster	N/A	N/A
	Buy Abrasion Media for Sand blaster	N/A	N/A
	Buy/Rent Air compressor	N/A	N/A
	Set up Equipment	N/A	15 mins
	Display Outerwear outside to be tested	N/A	2 min
	Tape 3 Zones on back of each outerwear piece for testing	N/A	5 min / Garment
Data Collection	Spray entirety front of bibs @ 30” away from product (spray evenly covering product)	Record sand effects on: Notions, Seams Fabric, pockets (Qualitative)	15 mins
	Spray entirety front of jacket @ 30” away from product (spray evenly covering product)	Record sand effects on: Notions, Seams, Fabric, Pockets (Qualitative)	15 mins
	Flip products over to reveal taped zones	N/A	1 min
	Spray Zone 1 on pants at 10” away	Damage rating	30 seconds
	Spray Zone 2 on pants at 10” away	Damage rating	1 minute
	Spray Zone 3 on pants at 10” away	Damage rating	1 minute 30 seconds
	Spray Zone 1 on jacket 10” away	Damage rating	30 seconds
	Spray Zone 2 on jacket 10” away	Damage rating	1 minute
	Spray Zone 3 on jacket 10” away	Damage rating	1 minute 30 seconds
Post Data Collection	Analyze Data for Conclusion	N/A	N/A

Mobility Study

PHASE OF STUDY	PROCEDURE	DATA COLLECTED	TIMING

Preparation	Travel to Beach with Test Athlete	N/A	1 hr. 30 min
	Set up Essential Movements Area	N/A	<10 mins
	Explain movements to test athlete	N/A	5 mins
Data Collection	Run from marker to marker in base layer	Mobility rating	2 mins
	Walk from marker to marker in base layer	Mobility rating	2 mins
	Squat in base layer	Mobility rating	2 mins
	Recline on ground in base layer	Mobility rating	2 mins
	Walk uphill to marker in base layer	Mobility rating	2 mins
	Walk downhill to marker in base layer	Mobility rating	2 mins
	Repeat Essential movements in base layer 2 more times	Mobility ratings	24 mins
	Have athlete put on outerwear for testing	N/A	< 5mins
	Run from marker to marker in outerwear	Mobility rating	2 mins
	Walk from marker to marker in outerwear	Mobility rating	2 mins
	Squat in outerwear	Mobility rating	2 mins
	Recline on ground in outerwear	Mobility rating	2 mins
	Walk uphill to marker in outerwear	Mobility rating	2 mins
	Walk downhill to marker in outerwear	Mobility rating	2 mins
	Repeat Essential movements in base layer 2 more times	Mobility ratings	24 mins
Post Data Collection	Average Mobility scores for base layer in each essential movement	Essential Movements average mobility scores for base layer	10 mins
	Average Mobility scores for outerwear in each essential movement	Essential Movements average mobility scores for outerwear	10 mins
	Analyze Data for Conclusion	N/A	N/A

MATERIALS


Cotton


Wool


Linen

The current materials on the market are identified as ideal for combatting the elements of the desert. These textiles include Cotton, Merino Wool, and Linen (Slovic, 2018). The collection will utilize naturally derived materials for the majority of my products. It is important that in a time of global climate crisis designers don't contribute to the problem as well as the athlete they are designing for. Cotton's properties allow for breathability but most importantly it holds moisture and will therefore hold sweat longer in its fibers (Slovic, 2018). This feature can keep your skin colder, longer, in hot desert conditions and allow for evaporation of the moisture during the day (Slovic, 2018). Similar to cotton, Linen is also a key fabric for desert life. It is twice as strong as cotton, dries faster than cotton, and is also absorbent (IDYLLO, 2020). Another essential desert fabric is merino wool (Slovic, 2018). It is incredibly soft on skin, has stretch which allows freedom of movement, and absorbent as well as moisture-wicking (The Best Shirt For Desert Hiking, 2019). Merino wool is also great due to its anti-odor abilities, absorbing odor caused by bacteria and trapping the smell (Slovic, 2018). Finally, University of Maryland developed a self-cooling fabric that isn't being commercially used yet but the technology is incredibly applicable (Dzierzak, 2019). This is one of the first textiles that is able to respond and change its' structure according to environmental conditions (Dzierzak, 2019). Researchers led by YuHuang Wang and Ouyang Min, made a self-regulating fabric from infrared-sensitive yarn that reacts to temperature and humidity (Dzierzak, 2019). When the wearer gets hot and sweaty, the carbon layer tightens, drawing the strands closer together to create gaps in the fabric making it more breathable (Dzierzak, 2019). When the wearer is cold or dry the fibers expand to capture heat (Dzierzak, 2019). Overall, naturally derived fibers will provide a sustainable option for performance apparel (Girijappa, 2019).

NATURAL MATERIALS

This initiative considers the Desert Nomad's story as they survive in a new world altered by the inaction of those before him. It is our responsibility to take action and consider natural materials in manufacturing. Natural materials are especially important for this project because of the ability to locally source these materials. As land becomes infertile due to desertification Desert Nomads use sheep as a food and fiber source as well as employing methods of

hydroponics to grow food as well as resources. Hydroponics will allow the nomads to grow crops like cotton or flax with less water, no soil, and a greater yield (Verticalroots. 2020).

As synthetic materials became mainstream it became apparent that they were damaging the environment (Girijappa, 2019). This discovery sparked an initiation of consideration of the development of eco-friendly materials. Natural Fibers are sustainable materials that are accessible in nature and are low-cost, lightweight, renewable, and biodegradable (Girijappa, 2019). Natural materials are also comfortable on the skin, break in nicely, and have lots of performance benefits including breathability, absorbency, and durability (Girijappa, 2019). As we watch the world around us change, and global warming continues to progress, we must do what we can to minimize the impact of our products on the Earth.

CURRENT MANUFACTURING

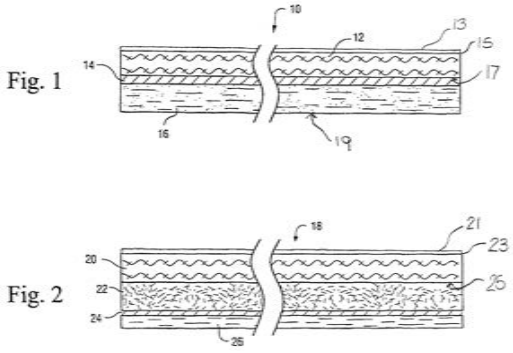
Duck Canvas and Denim constructions

The current manufacturing methods range across many avenues of outerwear and garment construction. Consideration in manufacturing natural workwear apparel consist of adding features for increased mobility, increased durability, and added insulation, as well as adding coatings for different properties (MasterClass, 2020). Natural yarns are tightly woven to create durable Cotton canvas, as well denim (What is Duck Cloth?, 2020). Cotton is also knit to create stretch capability as well as specialized properties (MasterClass, 2020). For example, waffle knit offers more space for air to be trapped between the garment and user to increase both breathability and insulation (MasterClass, 2020). Garments are usually sewed, surged, or flat seamed to depending different textiles and mobility capabilities (Little, 2016). Some stitches are preferable for durability versus anti-chafing depending on the fit or purpose of garment (Little, 2016). Apparel often includes notions or systems of adjustability, for example a draw string or suspenders (Little, 2016). Pattern features such as a gusset or dart can improve the fit and mobility of garments (Little, 2016). Some pants and tops are reinforced with fabric at abrasion zones such as the elbows and knees to increase the durability of the garment (Little, 2016). Coatings are utilized for added UV protection, waterproofing, and abrasion resistance. Waterproof coatings such as Gore-Tex or DWR are added to fabrics at the factory to make them hydrophobic (Little, 2016). Abrasion resistance is added when yarns are coated in certain polymers like acrylonitrile butadiene styrene, to increase textile strength (Wortmann, 2018). Textiles can also be coated to protect from UV (Little, 2016). An eco- friendly iron titanate nanoparticle derived from natural resources (like ilmenite sand was coated onto cotton fabrics to develop a UV-shielding property (Dhineshbabu, 2018). Manufacturing consideration is incredibly important for this collection as many of my design decisions will be executed in an order of operations making one construction step essential before the next (Little, 2016). This

collection will utilize innovative construction planning and execution to create outerwear and garments that will protect Desert Nomads from the dust storms of the desert.

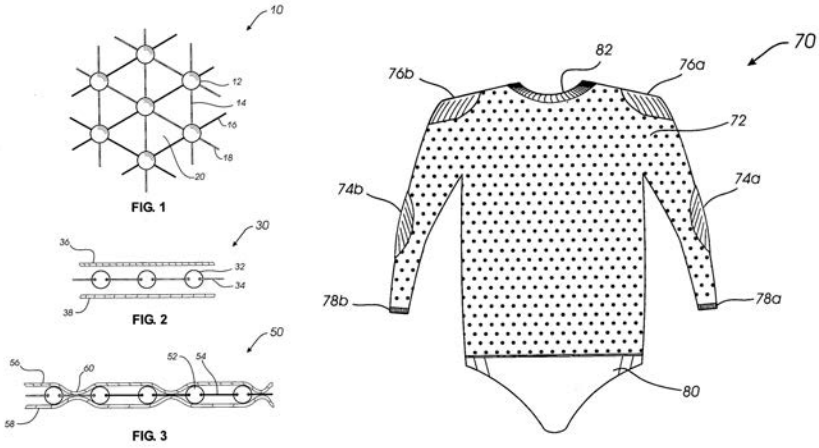
PATENT EXPLORATION

When looking into the intellectual properties associated with outdoor outerwear and garment technology there were a few applicable patented technologies that were applicable to the collection. First, a patent on Zoned Functional Fabrics that allows garments to be segmented for different properties (Blackford, 2013). These properties allow the material to direct heat, absorb heat, emit heat, and or wick moisture while also maintaining the desired transfer properties of the base material (Blackford, 2013). This technology allows for one garment to include a multitude of properties for different experiences (Blackford, 2013).



Protective Covers (Thompson, 2018)

Another patented technology relevant to this collection is called Protective Covers (Thompson, 2018). This is a multi-layer fabric that acts as a protective cover with a top, bottom textile layers, and an air permeable, moisture-vapor-transmissive, middle layer (Thompson, 2018). The top layer is increases resistance to abrasion while resisting outdoor elements such as solar radiation, temperature, and humidity (Thompson, 2018).

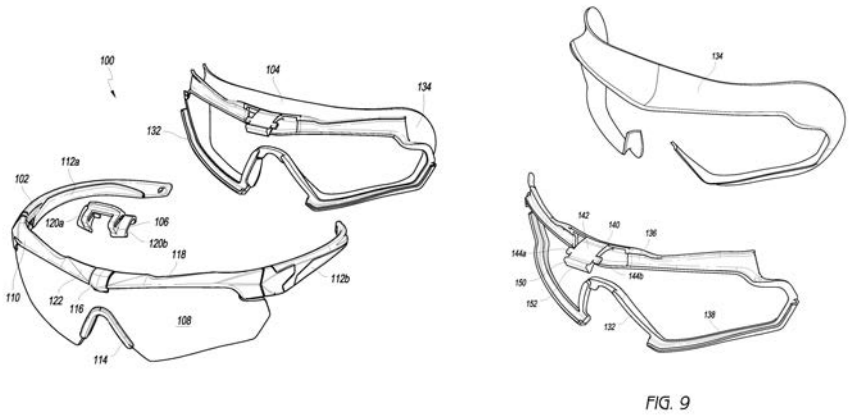


Abrasion Resistant Conformal Beaded-Matrix (Rast, 2004)

A patent called Abrasion Resistant Conformal Beaded-Matrix for use in Safety Garments describes an abrasion resistant garment that is highly ventilated while protecting the wearer during a slide or fall (Rast, 2004). The material is produced with beads that are held within a matrix of high-tensile strength, abrasion-resistant, cords (Rast, 2004). The matrix can be changed with layers to form a lining and or exterior (Rast, 2004). Under sliding friction, the beads rotate to an extent which tightens the cord matrix and keeps the wearers skin from making contact with the surface (Rast, 2004). All of these patented technologies are especially important because of their ability to protect and thermoregulate the athlete.

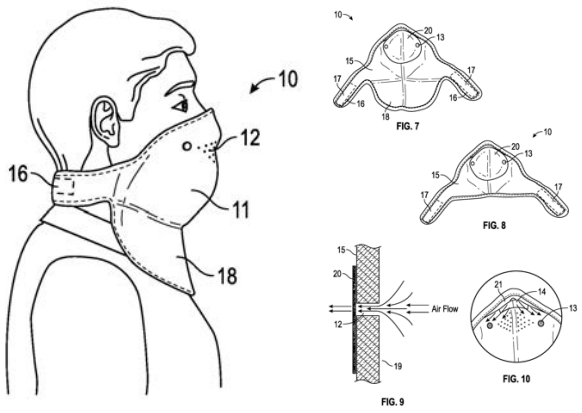
Hybridized garments are also relevant to the collection so patent exploration was essential. Tent Transformable into a Jacket is a patent developed by Mark Bahlig and Suzanne Bahlig (Bahlig, 1998). It consists of a flysheet, elastic shock-corded poles and a canopy (Bahlig, 1998). It is a four-sided pyramid with a dome structure created with two arching poles that run diagonally across the dome surfaced (Bahlig, 1998).

Finally, dust protection was an area to be explored when it came to state-of-the-art equipment. One patent for Eyewear having Multiple Ventilation States describes a product that provides eye protection as well as multiple levels of ventilation for dust protection (Belbey, 2016).



Eyewear Having Multiple Ventilation Sates (Belbey, 2016)

Another patent for dust protection when it comes to respiration prevention is an Adjustable Facial Conforming Face Mask (Smaller, 2017). It presents an adjustable face mask that conforms to the facial structure of the wearer (Smaller, 2017). The mask has a neck protector and removable filter with a strip of fabric designed to push air down to the sides of the wearer's face (Smaller, 2017). This will eliminate fogging of the wearer's goggles (Smaller, 2017).



Adjustable Facial Conforming Face Mask (Smaller, 2017)

COLOR AND GRAPHICS

Levi's Branding Example

Color Direction

When assessing the current market space's use of graphics and color competitor brands were referenced. Colors in these categories were majority neutral naturals with some contrast

color (Ellison, 2018). Companies also kept their branding to a minimal but distinct, sewing leather branding patches on apparel as well as smaller cotton tags (Ellison, 2018). If logos were present on garments, they were usually small or not visible on the outside (Ellison, 2018). Occasionally a statement piece could include larger logo for increased brand awareness (Ellison, 2018). The collection will follow the low-profile branding strategy as well as a statement piece that might include more branding than the other garments. When approaching color for my collection, it is important to understand that color can provide a function when it comes to desert survival (Kittmer, 2019). Dark color absorbs more heat than lighter ones because of their ability to absorb light energy (Kittmer, 2019). Dark colors reflect little solar light; therefore, they reflect less solar heat and are hotter (Kittmer, 2019). Although the sun isn't present during the day clothes may have a charging effect if left out during the day. Consideration of visibility is important because due to the lack of light while traveling. Nomads don't need to appear visible in desert, in fact blending into the desert landscape can be beneficial for combatting desert hostility. The collection will include dark neutrals in the base of my garments, outerwear and equipment, along with an accent color as pallet develops in aesthetic ideation.

SELF REFLECTION

With this project I will need to construct innovative patterns that allow for modularity, adjustability, and possibly dual functionality. I have experience with creating complex transformative outerwear as well as base layer garments. One of my strengths is my ability to visualize complicated patterns. My love for problem solving will help me creatively utilize the materials and tools I have access to enable to create functioning product. With this collection I hope to explore my interest in functional products as well as more conceptual ones. I want to create innovative solutions to technical problems by utilizing materials that the earth provides. I believe that my collection will transport its' audience to a world that future generations may be forced to adapt to. The designs will be complex yet intuitive, enabling the audience to realize the efficacy of the design as well as the individuality of the aesthetic. The conceptual reliability of my project suggests it could exist within the fashion industry. While also solving for physiological problems common in the outdoor industry. With this collection, I hope to make ripples in both. I will use heritage inspired materials to drive my design along with modern elements in my construction. I will demonstrate my ability to balance many products at once and still deliver a quality finished product by a deadline. I hope to someday be employed as a Creative Director at a brand where I will continue to balance the progress of many products at once with unifying design language to create a holistic collection.

I will create garments, outerwear, and equipment, from naturally derived materials, that can protect people and provide shelter from the harsh dust storms. Moreover, these products will protect the earth, as their materials are more sustainable than synthetic counterparts.

BENCHMARK PRODUCTS

I picked these products because they utilized natural fibers, had a baggy silhouette, were insulative for colder environments, and were designed for an active user. These products are very heavy duty which was important to me because of the amount of sand/dust abrasion my garments would experience. They also provide full body protection which is important for my user.

Carhartt:
Loose Fit Firm Duck Insulated Bib Overall
$109.00
(Black)
Materials: 12 oz. 100% ring-spun washed cotton duck canvas

Carhartt:
Washed Duck Insulated Active Jac
$119.00
(Khaki)
Materials: 12 oz. 100% ring-spun washed cotton duck canvas

Army Surplus:
Balkan Exploratory Rucksack
$35.99
(White)
Materials: Color-washed canvas

INDIGENOUS DESERT NOMADIC PEOPLES APPAREL

Bedouin –

The Bedouin peoples are native to the Arabian Desert (Sabbah, De Jong, 2021). They are nomadic peoples that move herds of animals across the desert to find grazing lands (Sabbah, De Jong, 2021). Clothing is very culturally significant to their community. So much so that tradition dictates that the clothes of the deceased be left atop the grave to be adopted by whatever needy travelers pass by (Sabbah, De Jong, 2021). Their clothing covers their bodies in entirety as well as head and face protection accessories. They wear a Kufiyya which is a head cloth that can wrap around their face (Sabbah, De Jong, 2021). It remains secure with heavy woolen coils called an Agal (Sabbah, De Jong, 2021). On their body they wear a Tob; a large dress with triangular sleeves made of cotton, as well as a cord that secures the garment (Sabbah, De Jong, 2021). They also wear loose fitting trousers called a Shalwar (Sabbah, De Jong, 2021).

A Bedouin Man, Jerusalem, Syria, 1899

Tuareg -

The Tuareg peoples are native to the Sahara Desert (Tuareg, 2021). They are semi-nomadic herders that will travel great lengths to find grazing lands and water sources (Tuareg, 2021). They are especially known for the Indigo Veil they wear (Tuareg, 2021). They travel in camel caravans across the desert (Tuareg, 2021). Their apparel includes and indigo veil to protect their head and face from sun and sand as well as a flowing gown or Bubus that covers their entire body (Tuareg, 2021). This gown allows air flow while deflecting heat and blowing sand (Tuareg, 2021).

Tuareg Guide, Timbuktu, Mali, 2008

Navajo -

The Navajo people are native to the Great Basin Desert (Native American Indian tribes, 2018). They are semi-nomadic hunters and gatherers that herd sheep and goats for resources as well as food (Native American Indian tribes, 2018). Women spin and weave wool into cloth (Native American Indian tribes, 2018). Men mainly hunt for food and protect the community. Men typically wear ponchos or blankets made of wool as an outer layer (Native American Indian tribes, 2018). Long, wool tunics are secured with a belt as well as a cloth or leather head band (Native American Indian tribes, 2018). Women typically wear skirts or dresses made of Yucca (Native American Indian tribes, 2018).

Navajo Man Wearing Serape, 1883

Mongolians -

The Nomadic Mongolians are nomadic herders that are native to the Gobi Desert (Asia for Educators, 2021). They typically travel the desert in search of grazing lands for sheep, goats, or cows (Asia for Educators, 2021). Their clothing protects their entire bodies. A Deel; is a wrapped outer garment made from cotton, silk, wool, or brocade that is usually as long as the wearers knees (Asia for Educators, 2021). The garment is pulled against the wearers body and clasped in place (Asia for Educators, 2021). The Deel is secured with a large sash made of silk or leather that can also create a large pocket between the flaps and above the belt (Asia for Educators, 2021). Deels have wide sleeves that are sometimes referred to as "hooves" (Asia for Educators, 2021).

Modern Mongolian Herder, 201

MOBILITY TESTING AND DATA COLLECTION

Mobility Rating

1 = EASY	**5 = HARD**					
BASE LAYER	RUN	WALK	SQUAT	RECLINED	UPHILL	DOWNHILL
RATING 1	1	1	3	2	1	1
RATING 2	2	1	2	2	1	1
RATING 3	1	1	2	2	1	1
AVG. RATING	1.3	1.0	2.3	2.0	1.0	1.0
OUTERWEAR	RUN	WALK	SQUAT	RECLINED	UPHILL	DOWNHILL
RATING 1	3	2	4	3	3	2.5
RATING 2	2.5	2	4	2.5	3	2
RATING 3	2	2	4.5	3	4	3
AVG. RATING	2.5	2.0	4.2	2.8	3.3	2.5

Results

The squat and uphill positions both yielded higher scores than any other essential movements. They were the most difficult movements to perform when wearing the outerwear.

It will be important to better accommodate hip and knee hinge movements when prototyping and ideating.

SANDBLASTING TESTING AND OBSERVATIONS

#	Garment	Details	Observations
1	Carhartt: Loose fit firm duck insulated bib overall	12 oz. Cotton Canvas	Sand embedded in yarns, abrasion on woven fabric, sand in snap buttons, sand pooling in pockets
2	Carhartt: Washed Duck Insulated Active Jac	12 oz. Cotton Canvas	Sand embedded in yarns, sand pooling in pockets, abrasion on seams and fabric, sand in zipper
3	Army Surplus: Balkan Exploratory Rucksack	Color-washed canvas	Sand build up on external features, sand in seams, abrasion on woven fibers

Sandblasting Process:

1)

2)

Sand **No Sand** **Sand** **No Sand** **Sand** **No Sand**

3)

1)

2)

3)

Results

Sand easily infiltrated yarns and fibers causing abrasion but not total rupture. Sand also made trims more difficult to use including zippers, snap buttons, and adjustment buckles. Sand was pooling in the pockets making it difficult to dispose of as well as infiltrating stored gear. It will be important to pick trims that will not be affected by sand as well picking materials strategically for durability. Features may also require innovative construction to avoid sand infiltration.

IDEATION GOALS

<u>First Priority</u>

Sand and Dust Protection

- Sealing garments from sand infiltration
- Storage features that keep sand out
- Body, head, and face protection

<u>Second Priority</u>

Increased Mobility

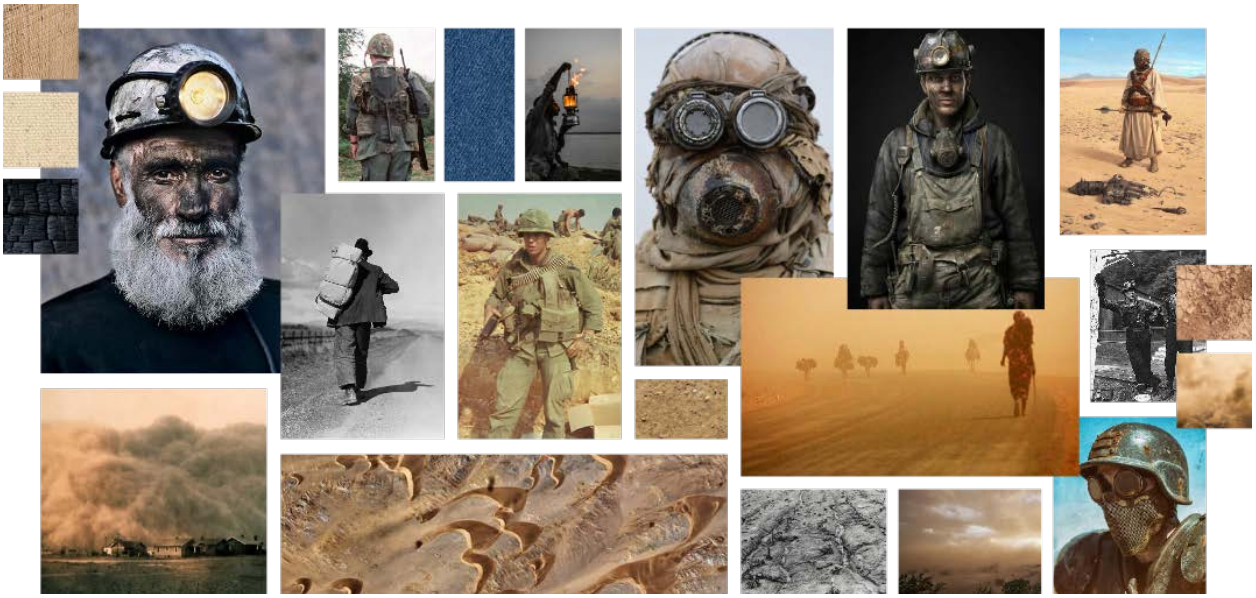
- Loose fit allowing for ease of movement
- Secure fit where needed (waist)
- Light materials with heavy for durability/insulation

<u>Third Priority</u>

Thermoregulation

- Breathable/Insulating Materials
- Adjustable ventilation
- Layering System

MOOD BOARDS

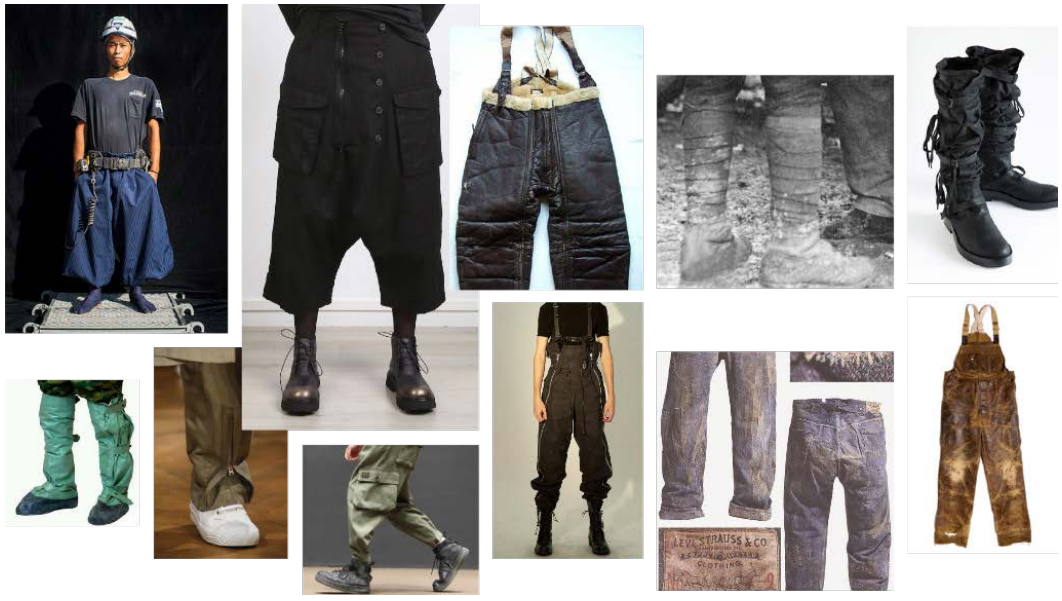


ALL PURPOSE PANT IDEATION

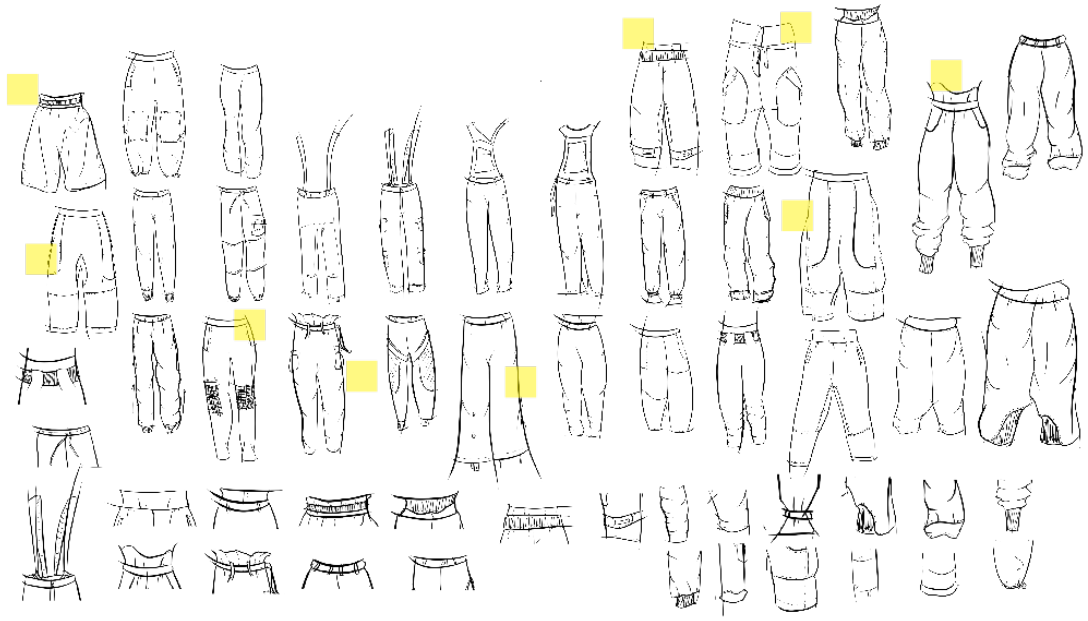
Essential Features

- Sand sealing cuff
- Loose Fit/Silhouette
- Gear Storage
- Durability features

Inspiration

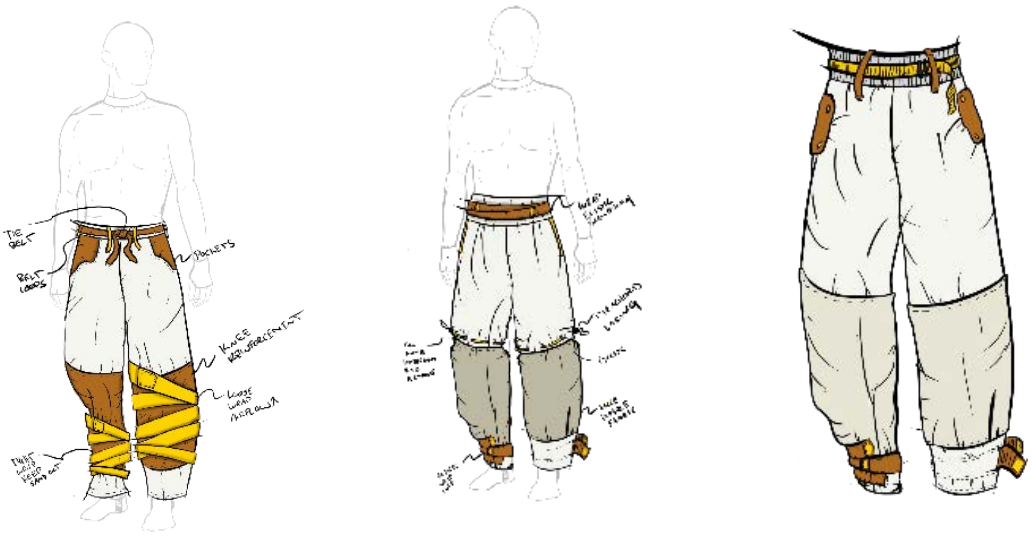


Thumbnails



Mobility Sketching

Conceptual Sketching



Final Concept

Prototypes

Material: Muslin

Features and Benefits

#	FEATURE	BENEFIT
1	Elastic Waist	Secure Fit // Mobility
2	Webbing Belt // O-Rings	Increased Stability on Waist
3	Belt Loops	For Belt and Gear Storage
4	Dust Resistant In-seam Pocket	Closure flap folds sealing pocket entry
5	Pocket Secure Tri Button	Keeps Pocket Closed, stores gear
6	Maximum Mobility Loose Fit	Mobility for all movements/positions
7	Durable Knee Overlays	Increased Durability against sand abrasion
8	Knot Loop Secure System	Keeps binding secure from unraveling
9	Threaded Elastic Sinch Cuff	Seals cuff opening from dust and sand

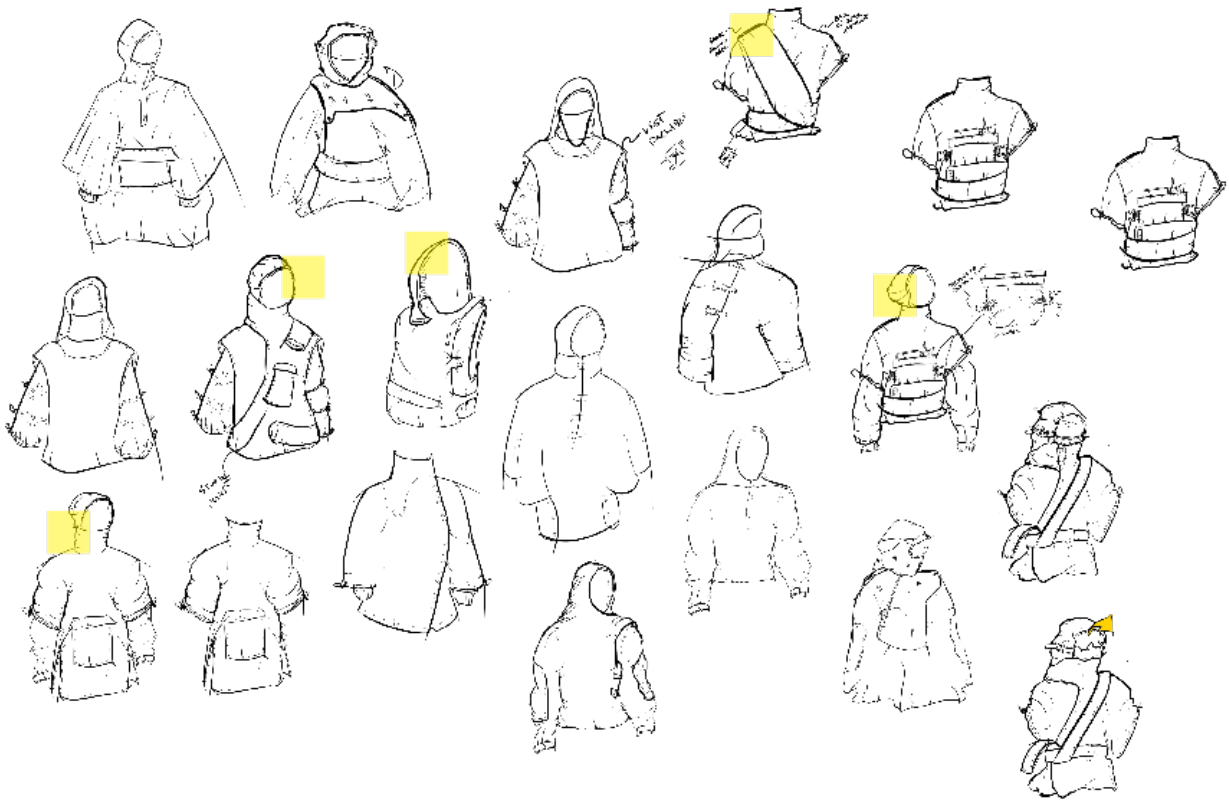
UPPER BODY OUTERWEAR SYSTEM IDEATION

Essential Features:

- Sand Sealing Cuff
- Head and face coverage
- Loose Fit/Silhouette

Inspiration

Thumbnails



Conceptual Sketching


PROTECTIVE HOOD
BUTTON PLACKET
STORAGE POCKET
RIBBED CUFF

STORAGE POCKET

WRAP HOOD
WRAP OVER SHOULDER
WRAP BELT
UNDER JACKET
VELCRO CUFF

FACE PROTECTION
SINCH CORD
OVER JACKET
SINCHED ARM HOLES
VELCRO CUFFS
SLITTED FOR MOBILITY
PACKABLE/ STORAGE


THICK WOOL
MEDIUM WEIGHT

LOOSE FIT
SINCH HOOD
ELBOW PATCH; DURABILITY
WRIST CUFF WRAP
EYELETS
MORE DURABLE FABRIC


WRAPS OVER SHOULDER
NECK TEXTURE
UNDER SHIRT STITCH PLAID
SLASHED ARMS
PACKABLE/ STORAGE
WRAP BELT
HOOD
ASYMETRICAL BUTTON DOWN (GREATHEART)
SLASHED CUFF W ELASTIC
SLASH SKIRT

Mid Layer Prototyping

Materials: Muslin/Elastic

Features and Benefits

#	FEATURE	BENEFIT
1	Fitted Hood	Protects head // Keeps head warm
2	High Neck Collar	Increased respiratory protection
3	Button Placket	Secures neck collar without sand infiltration
4	Open Collar Securing Button	Secures open collar to garment
5	Loose Fit	Provides mobility in arms/body // Airflow
6	Body Sinch	Wasit sinch to prevent sand/dust infiltration
7	Elastic Knot	Thread under wraps to secure binding
8	Elastic Binding	Closes cuff to preven sand/dust infiltration

Outer Layer Prototyping

Materials: Muslin, Elastic, Felt

Features and Benefits

#	FEATURE	BENEFIT
1	Large Hood	Protects head from dust and insulates
2	Wool Lining	Insulates outer garment
3	Neck Wrap	Protects nose and mouth
4	Loose Fit	Maximum mobility and allows airflow
5	Elastic Waist Wrap	Seals garment around waist from dust/sand
6	Arm Sinch	Seals arms to prevent sand/dust infiltration
7	Knotted Elastic Secure System	Loop knot under wrapping to secure binding
8	Storage pocket	Allows for gear storage protected from dust

ANTICIPATED METRICS AND VALIDATION

Extensive Dunes Mobility Test

I will ask my wear tester to wear the benchmark products for a day in the dunes and perform certain activities as well as just walking in the sand all day. I will then ask him to rate his perceived mobility while completing the activities as well as at the end of the day. He will then repeat this process in my prototypes hopefully yielding lower scores implying improved mobility.

Sandblasting Observations Test

I will Sandblast my prototypes using the same method as my benchmark products and observe abrasion effects as well as sand infiltration. My new garments should be designed to have full functioning trims and sand sealing features, despite the high velocity sand environment.

Materials Weight Test

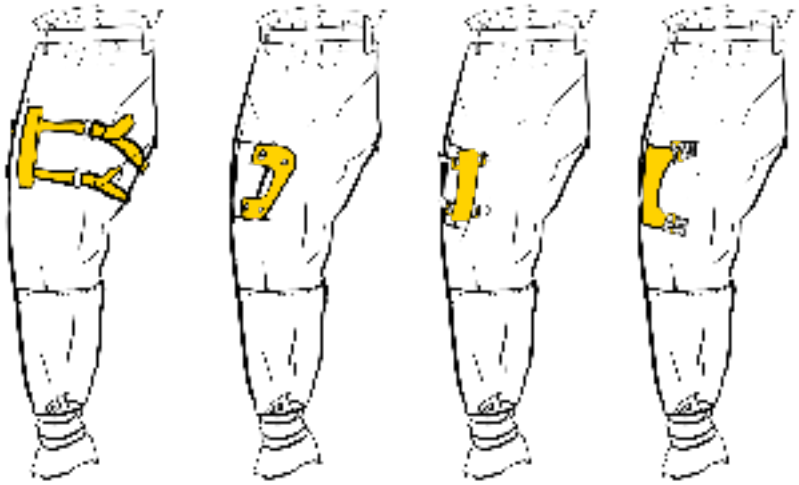
I will weigh my prototypes as well as my benchmark products and record the difference in mass. Currently my prototypes are **66%** lighter than my benchmark products, however, they

are not made in final materials. I estimate my final prototypes will be **30%** lighter compared to the benchmark products, providing greater mobility.

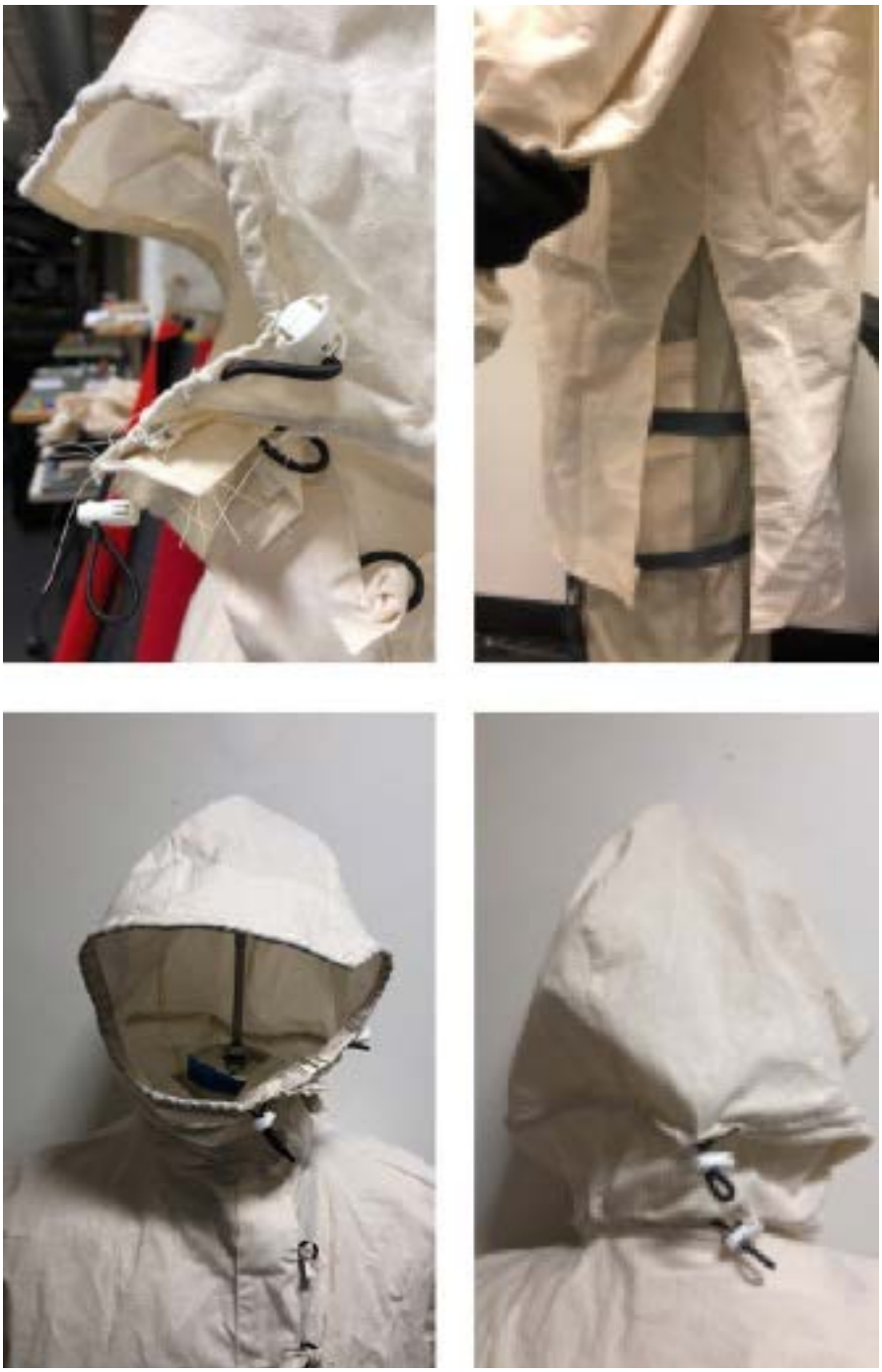
Category	Garments	Mass
Benchmark	All Outerwear	3.6 kg
Prototype	All Garments	1.2 kg

FURTHER PROTOTYPING/IDEATION

All Purpose Dust Pant

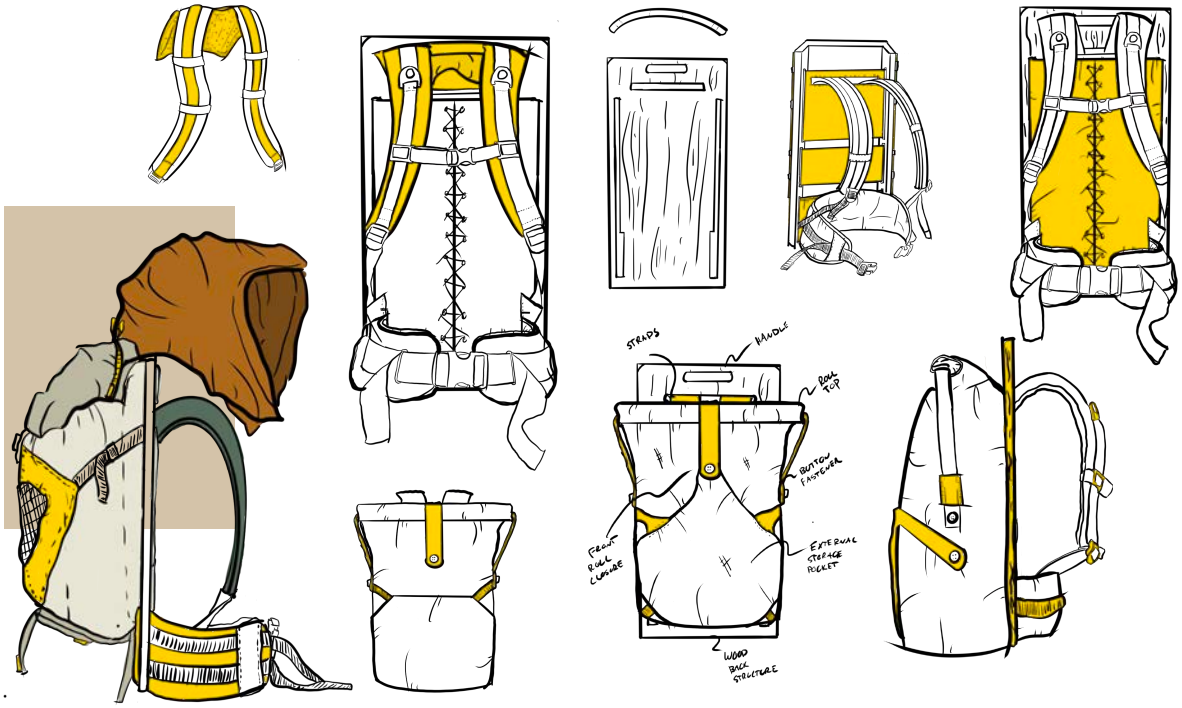


Dust Protection Pullover

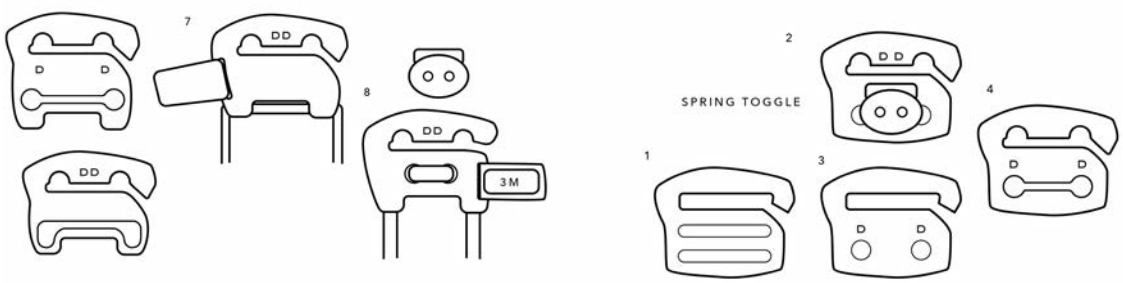


Warmth Wrap

Desert Commuter Pack

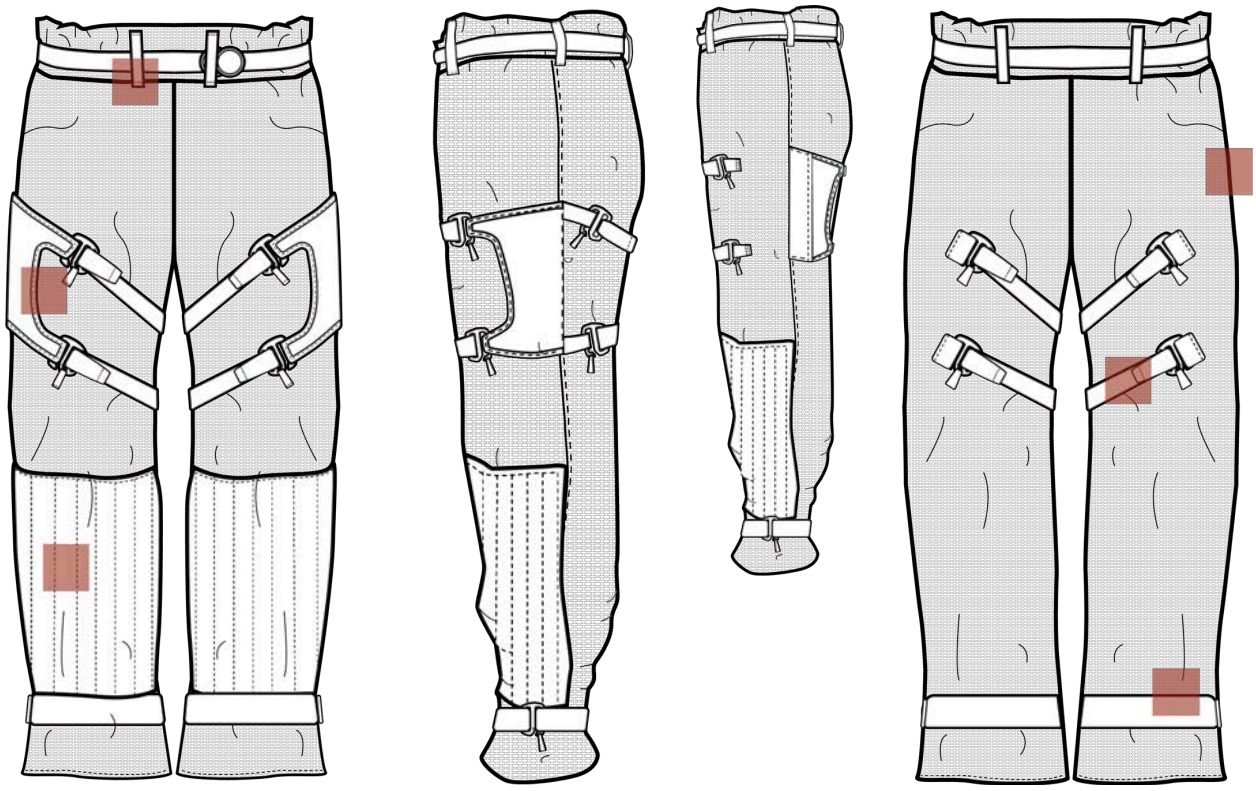


Multi-Functional G-Hook

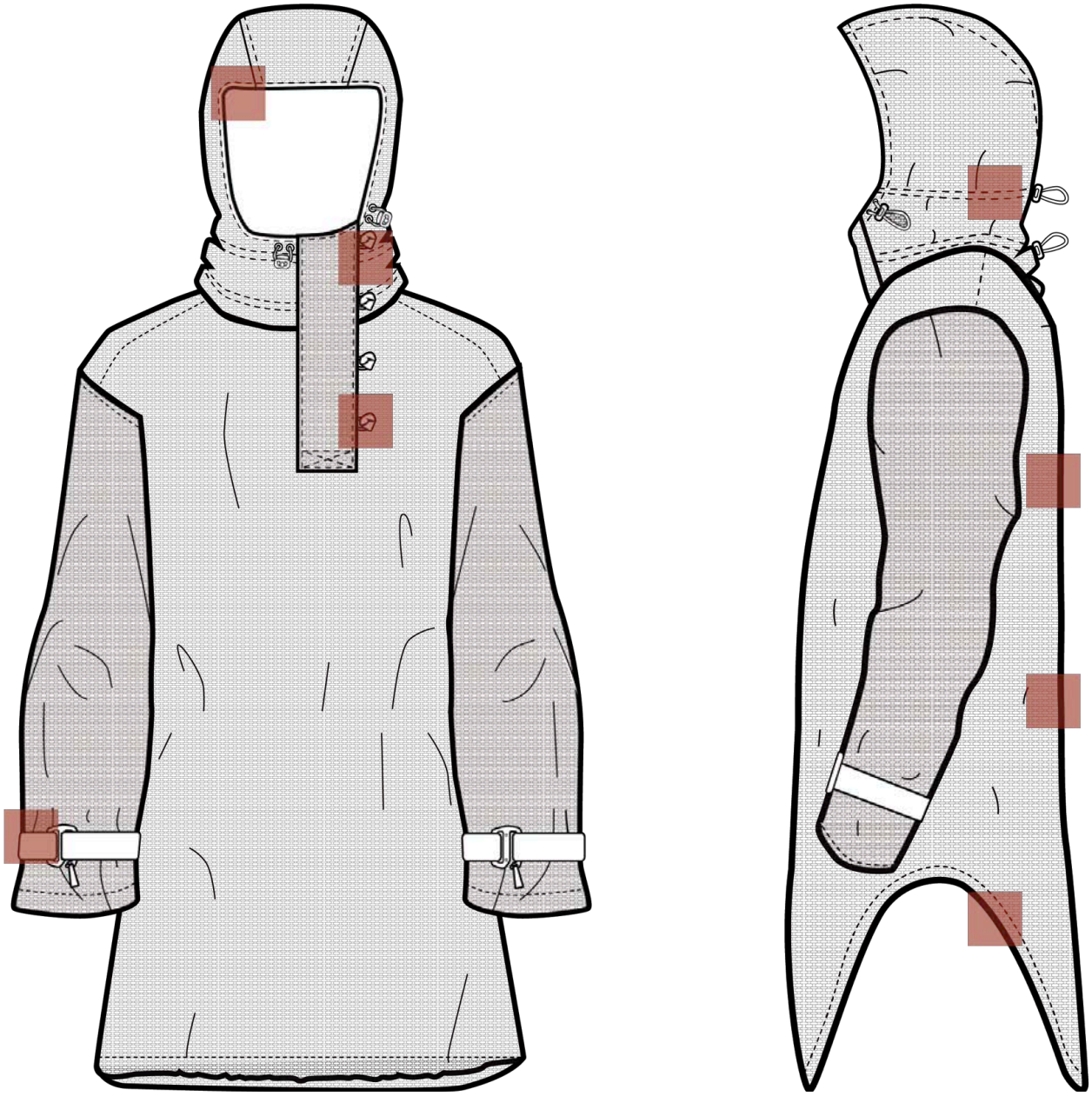


Aluminum (CNC) - this design is compatible with cord, rope, and webbing allowing the Desert Nomad versatility with materials and closures. A cut out is used for a pull 3M pull tab to easily identify the G-Hooks at night.

TECHNICAL DRAWINGS

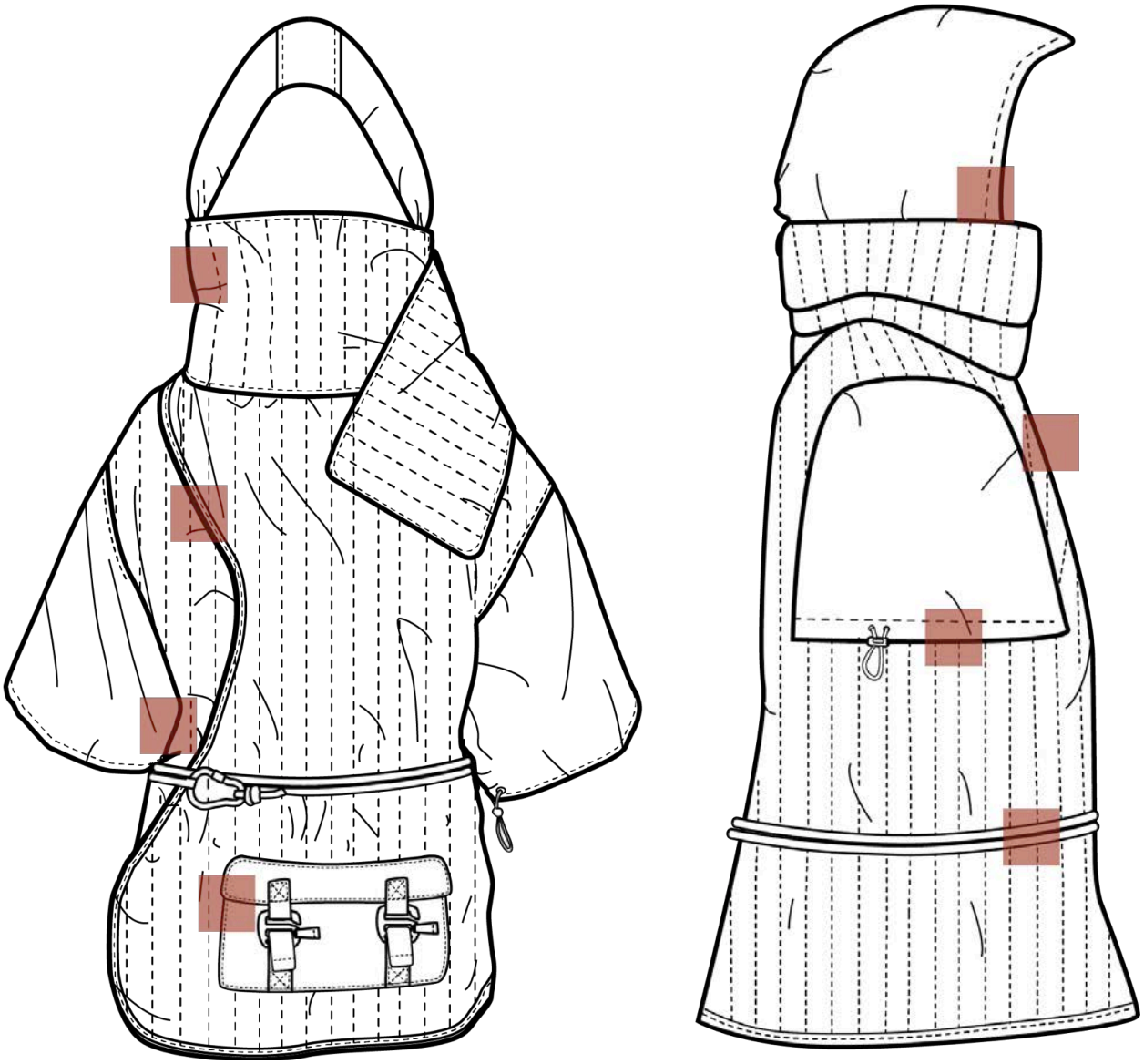


FEATURES	BENEFITS	MATERIALS/CONSTRUCTION
Belt Loops	Accommodates belt, stores gear	Linen // woven
Specialized Pocket	Keeps sand and dust out from infiltrating gear	Linen // woven
Reinforced Knee	Durability in high abrasion zone	Linen // woven
Loose Fit	Mobility	Linen // woven
Wrapped Webbing	Thigh cinch and pocket adjustability	Hemp // webbing
G-Hook Cuff Cinch	Prevents dust infiltration	Hemp // webbing



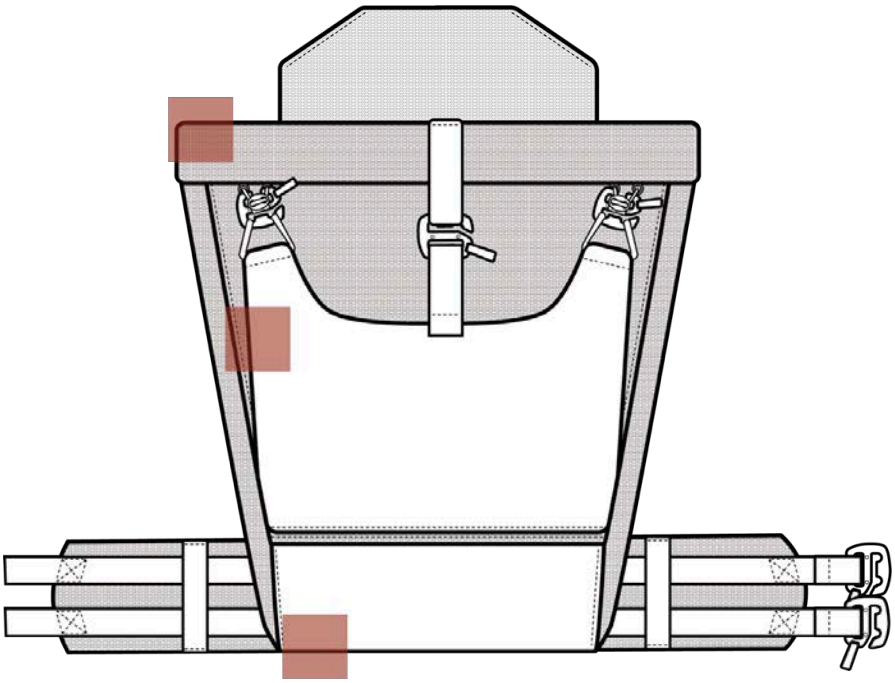
FEATURES	BENEFITS	MATERIALS/CONSTRUCTION
Face Cinch	Prevents dust infiltration	Nylon Cord/Spring Toggle
Storm Flap	Protects zipper from sand and dust	Hemp//Woven
Monkey Fist Knot	Secures storm flap	Paracord
G-Hook Cuff Cinch	Seals the cuff from dust	Aluminum // CNC
Neck Cinches	Adjusts for breathability and protection	Nylon cord/Spring Toggle
Baggy Fit	Improved Mobility	Hemp // Woven

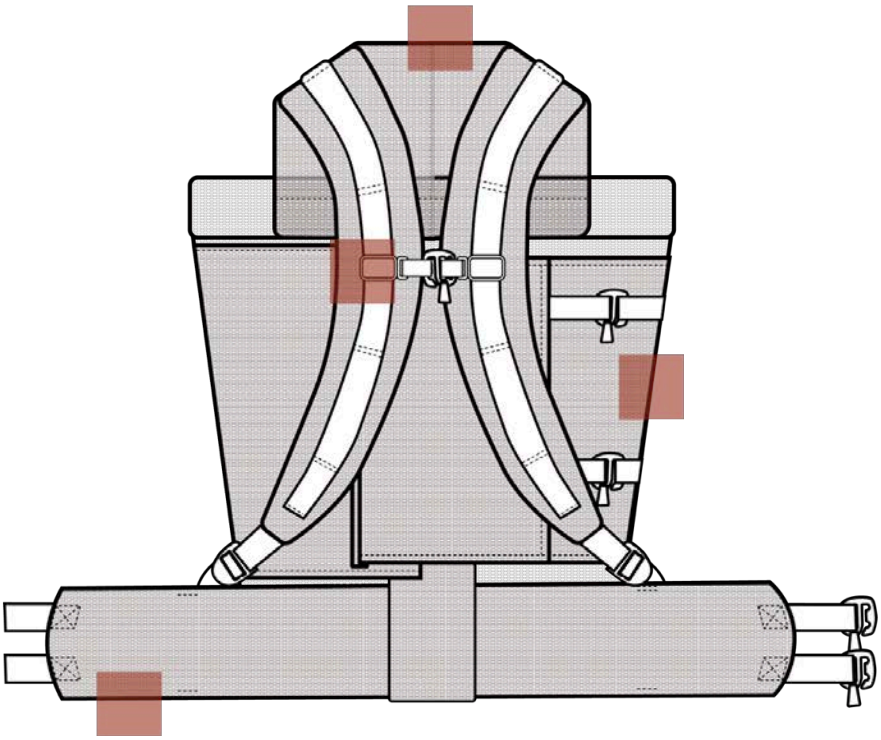
Long Silhouette	Dust infiltration barrier around waist	Hemp // Woven
Leg Cut Outs	Allows for increased mobility	Hemp // Woven

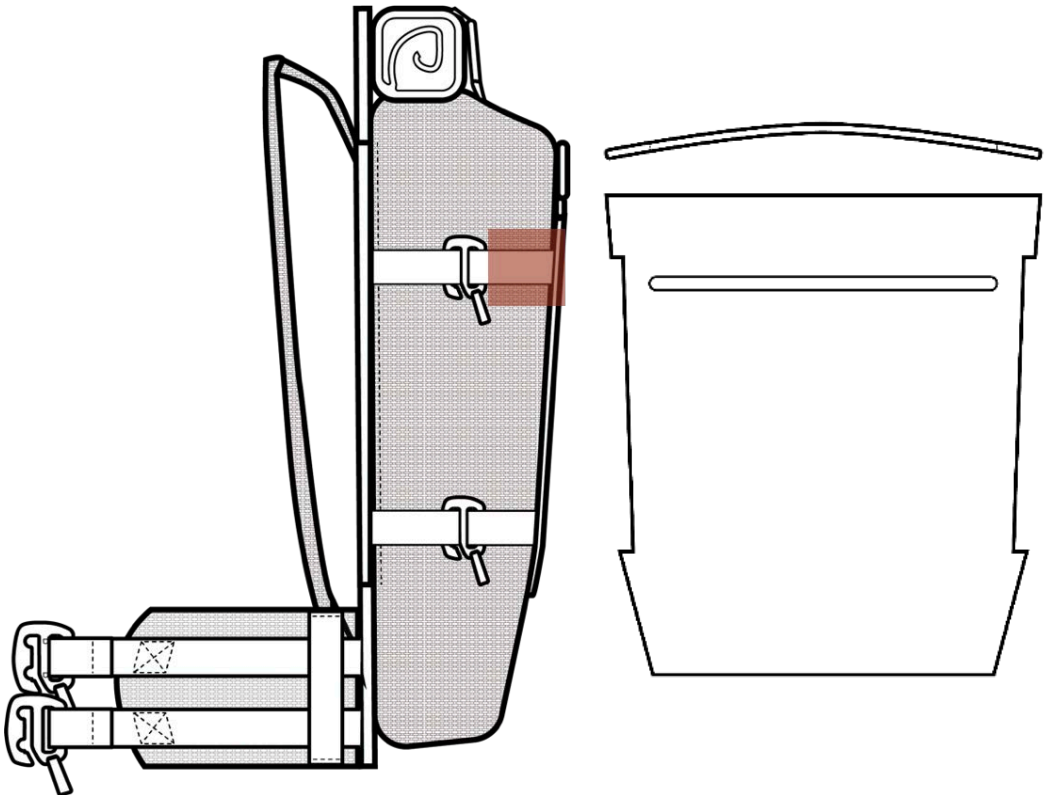


FEATURES	BENEFIT	MATERIALS/CONSTRUCTION
Wrap Face Covering	Protects face	Hemp // Woven
Natural Stow Pocket	Quick gear storage	Hemp // Woven
Baggy Fit	Mobility	Hemp // Woven
Storage Pocket	Gear storage	Hemp // Woven
Hood	Protection/warmth	Hemp // Woven
Baffles	Warmth	Hemp // Fill

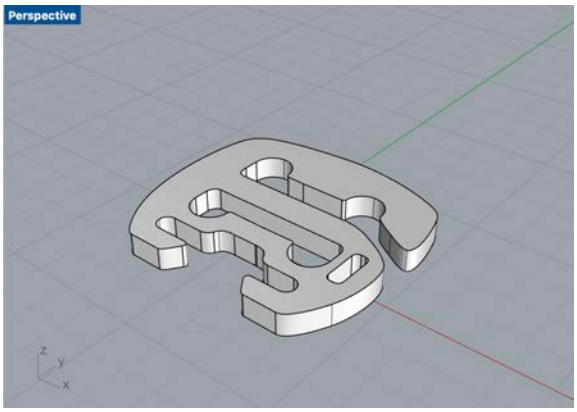
Arm Cinch	Keep dust out	Nylon Cord, Toggle
Rope Waist Closure	Close garment	Nylon Scrap Rope

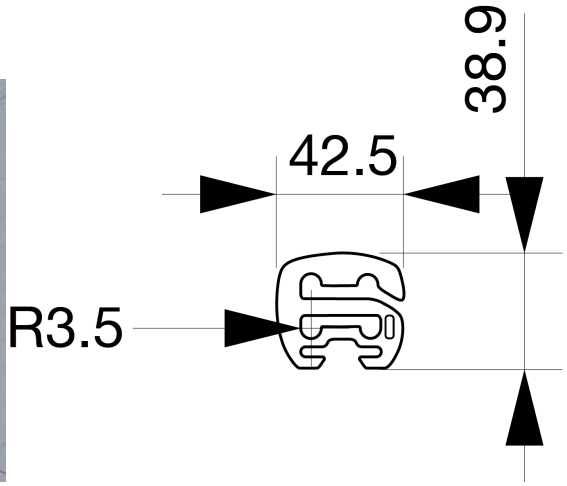






FEATURE	BENEFIT	MATERIAL/CONSTRUCTION
Bent Lamination Frame	Structure for pack	Cotton // Canvas
Roll Top Closure	Seals bag from dust	Cotton // Canvas
Front Stash Pocket	Quick stashing of gear/bedding	Veg Tan Leather
Reinforced Bottom	Durability	Veg Tan Leather
Shoulder Padding	Comfort	Closed Cell Foam (1/4”)
Sternum Strap	Secures pack to athlete	Hemp //Webbing
Adjustable Sides	Adjust pack depending on how much gear carried	Hemp // Webbing
Wrap Tension Closure	Barrier between athlete and frame	Cotton // Canvas Hemp // Webbing
Hip Belt	Distribute weight to hips	Closed Cell Foam (1/4”)

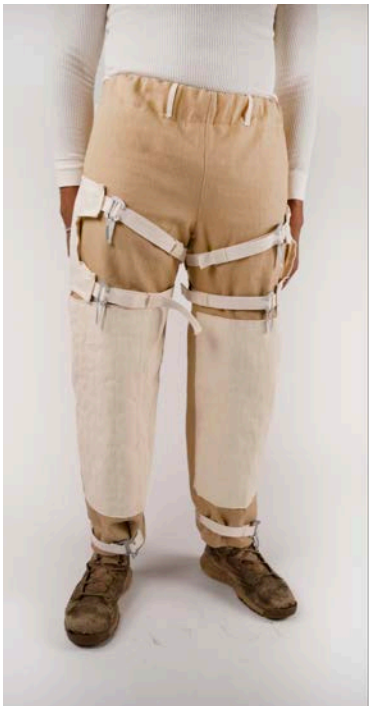


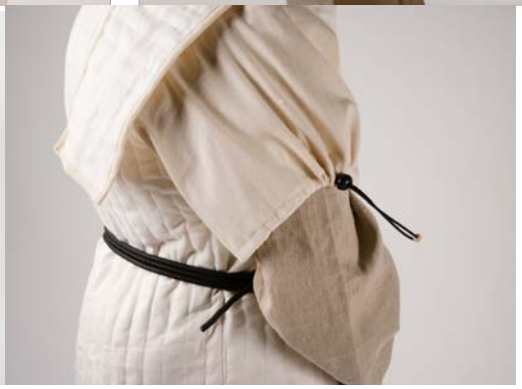


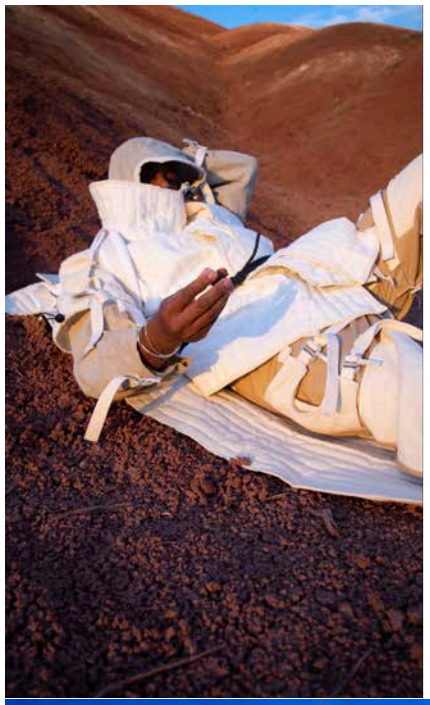
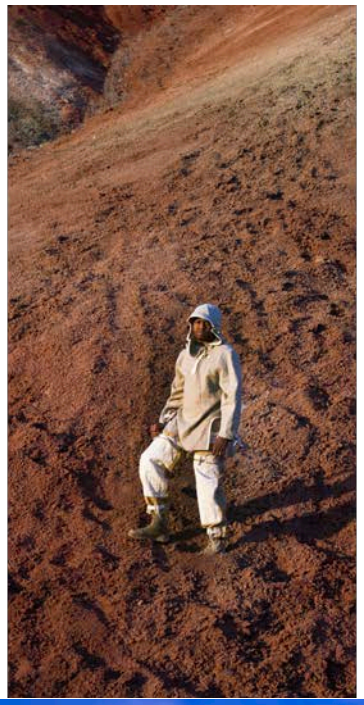
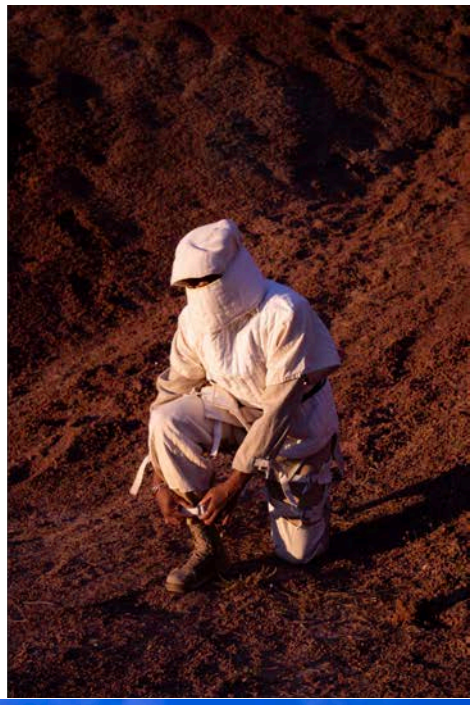
Garment Measurements

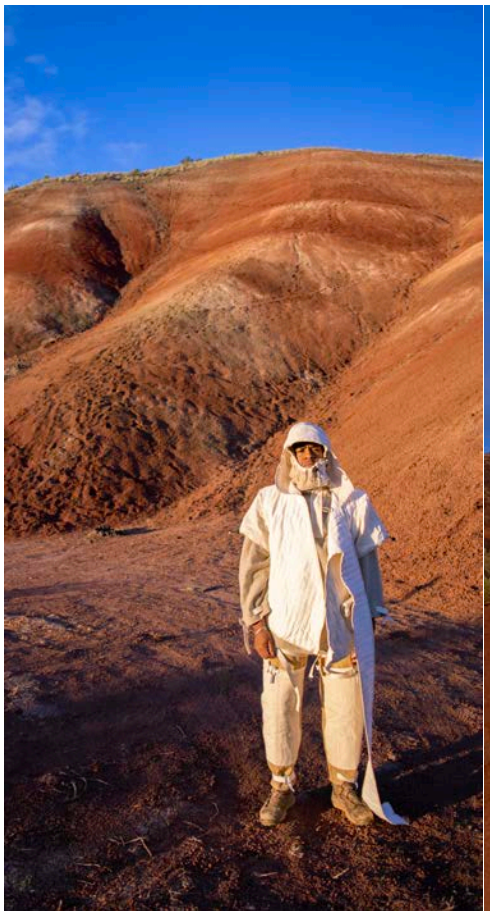
Chest: 41”
Waist: 34”
Hips: 41” High Hip: 38”
Inseam: 33”
Thigh: 25”
Upper Arm: 15”
Sleeve Length: 33.75”
Front Waist Length: 12.5” Back: 18”

FINAL PROTOTYPES







PACKAGING

Repair Kit - Swatches of all three main fabrics, an extra G-Hook, a Needle and thread, extra webbing.

VALIDATION

Outerwear Mass

These outerwear pieces are lighter than the benchmark garments tested, contributing to improved mobility in the prototypes.

CATEGORY	GARMENT	MASS
Prototype	All	2.9 kg
Benchmark	All	3.6 kg

Mobility Ratings Follow Up

Ratings improved for the Essential Movements with the final prototypes, proving ease of mobility in prototype garments.

Final Prototypes

OUTERWEAR	RUN	WALK	SQUAT	RECLINED	UPHILL	DOWNHILL
RATING 1	3	2	3	3	3	3
RATING 2	2	1	2	2	2	2
RATING 3	2	1	2	2	2	2
AVG. RATING	2.3	1.3	2.3	2.3	2.3	2.3

Benchmark Products

OUTERWEAR	RUN	WALK	SQUAT	RECLINED	UPHILL	DOWNHILL
RATING 1	3	2	4	3	3	2.5
RATING 2	2.5	2	4	2.5	3	2
RATING 3	2	2	4.5	3	4	3
AVG. RATING	2.5	2.0	4.2	2.8	3.3	2.5

Athlete Experience

After performing all of the movements on a hot day in the Painted Hills the athlete reported benefits of the hemp being breathable and wicking in the heat as well as the linen pants providing similar breathability.

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