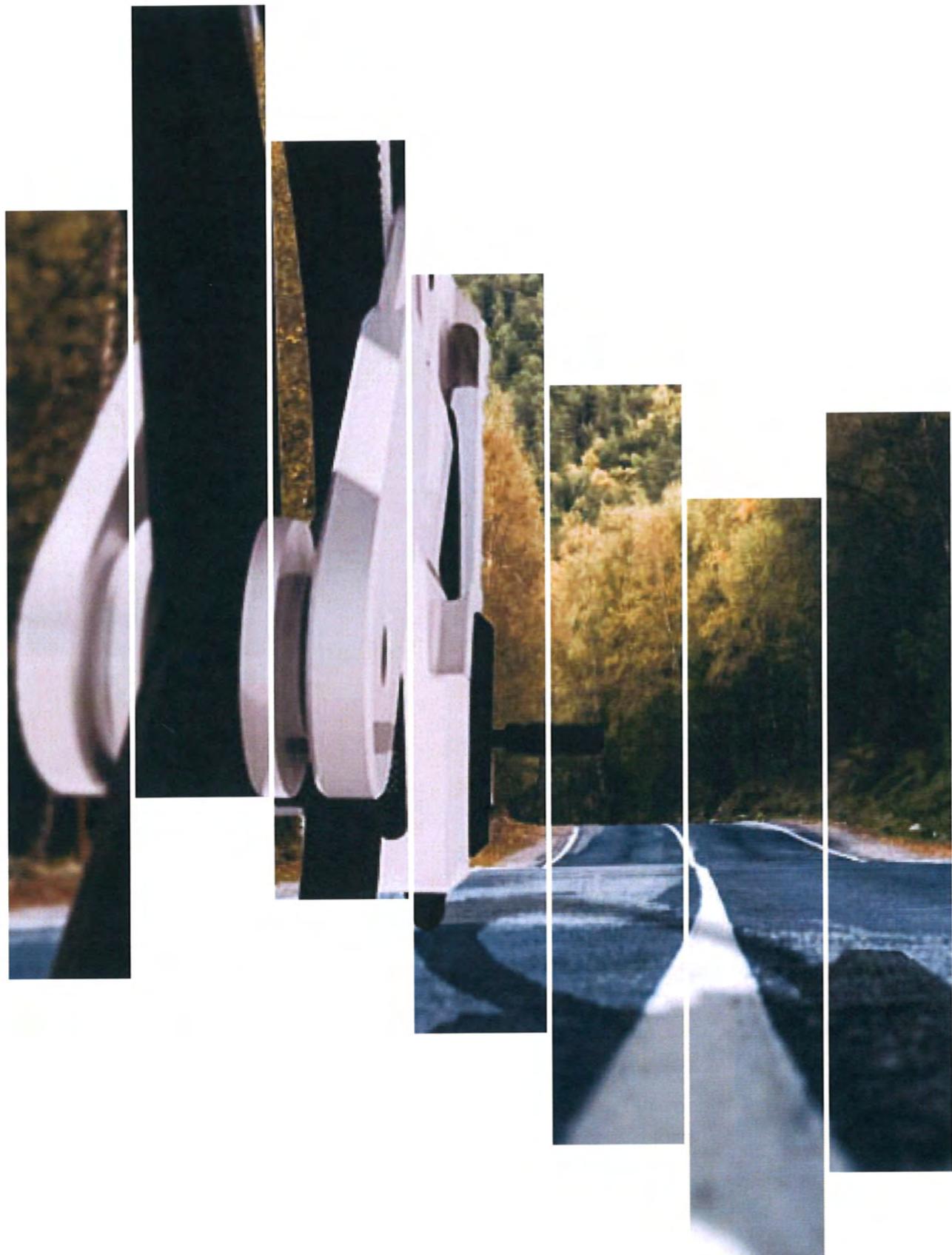


No part of the candidate evidence in this exemplar material may be presented in an external assessment for the New Zealand Scholarship award.



BICYCLE PROJECT

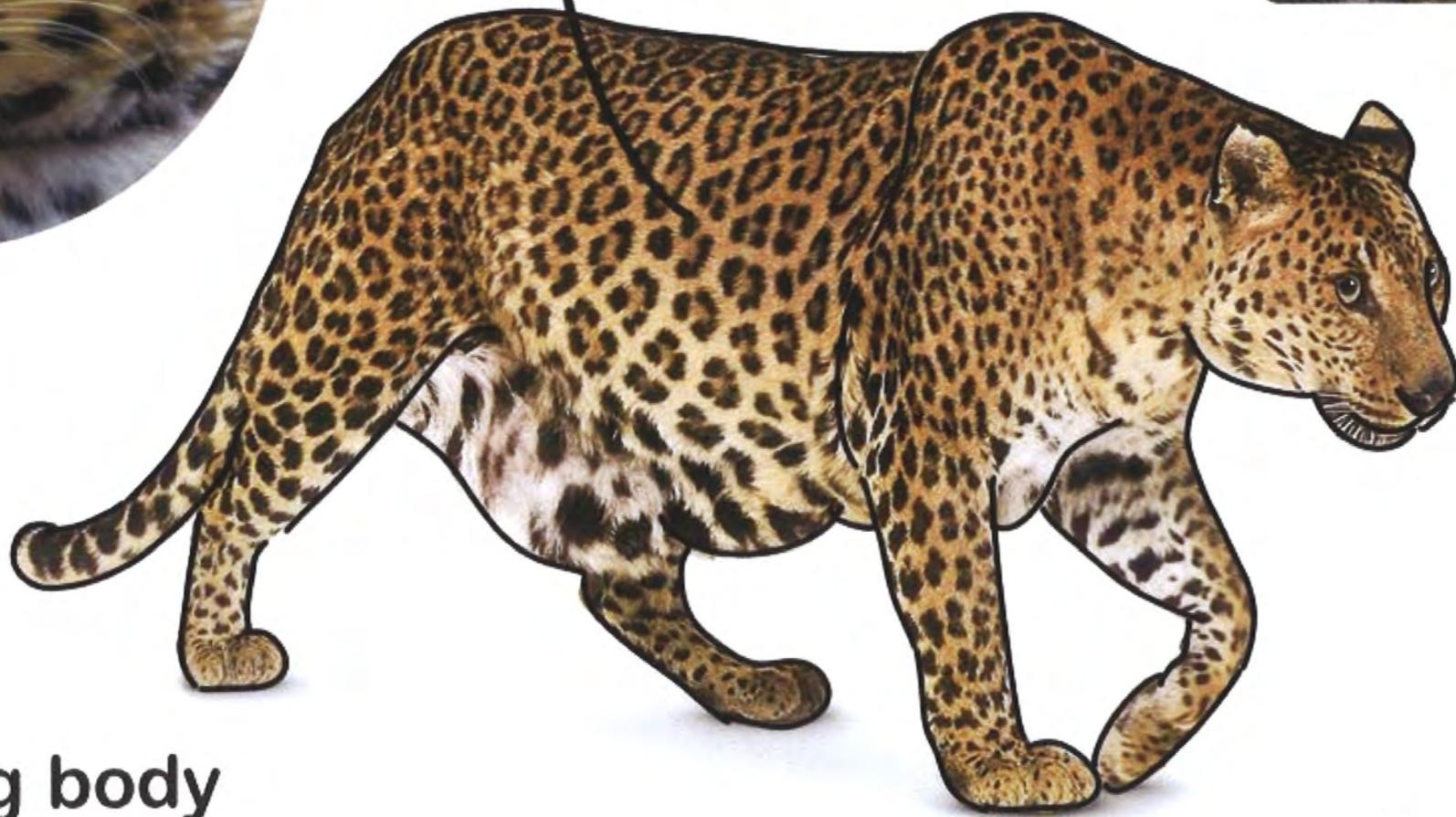


Rosette
mark
fur

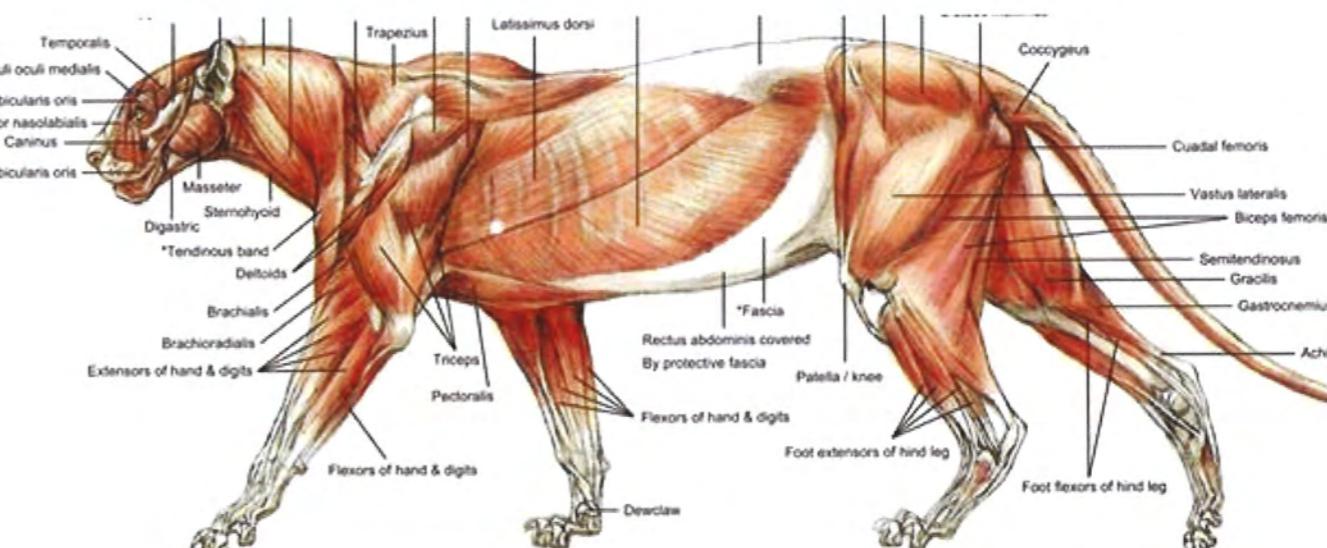
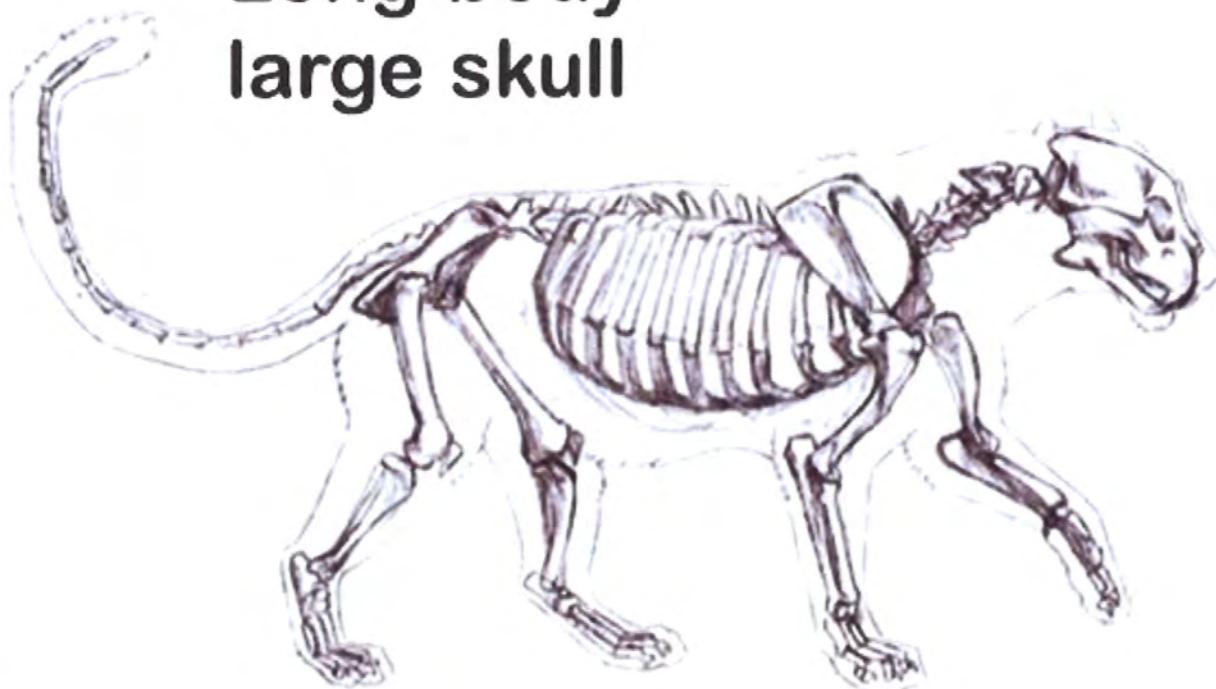


Excellent leaping
and jumping ability

The leopard (*Panthera pardus*) is one of the five extant species in the genus *Panthera*, a member of the cat family, Felidae



Long body
large skull

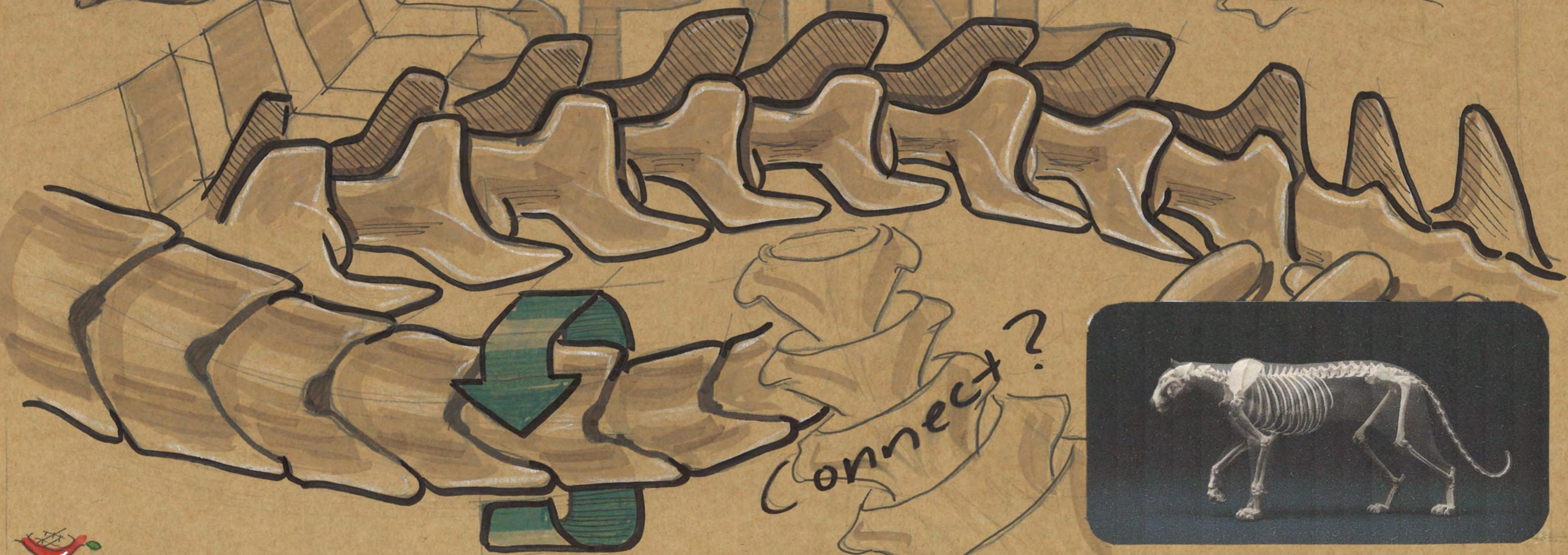
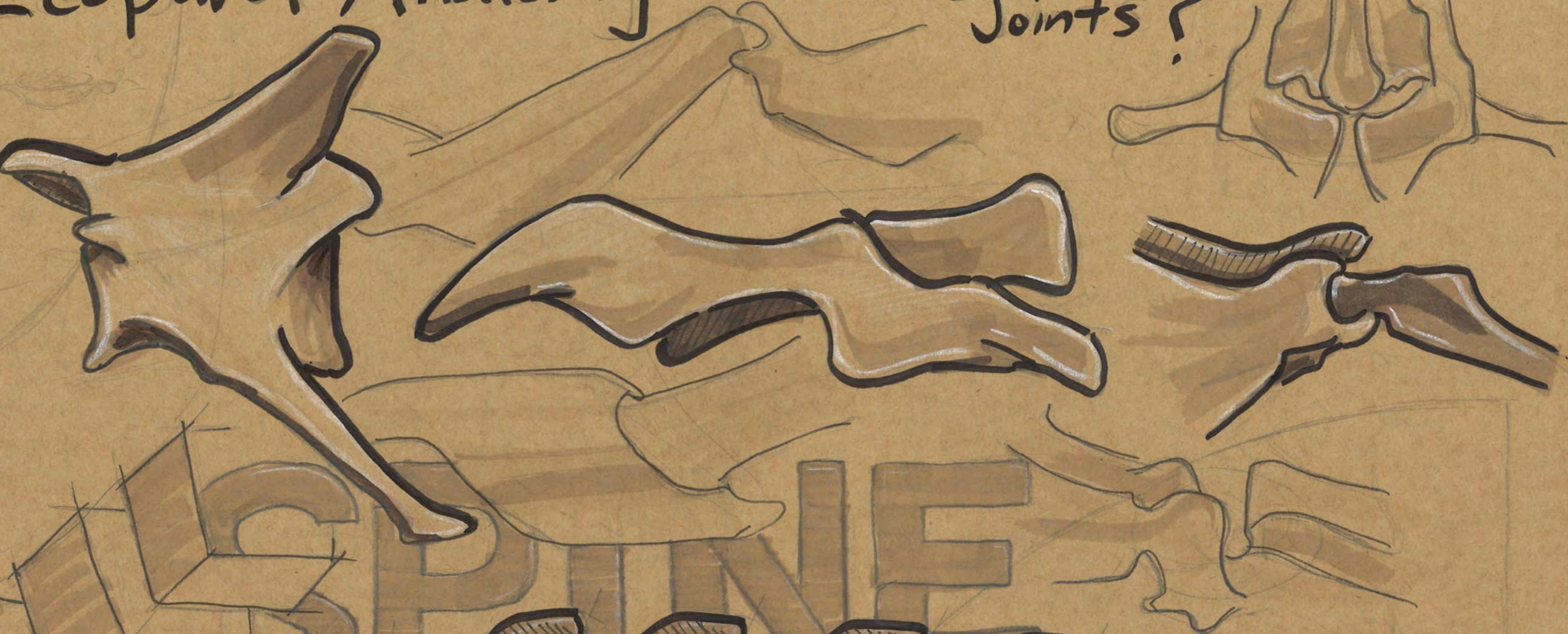


Leopard Anatomy

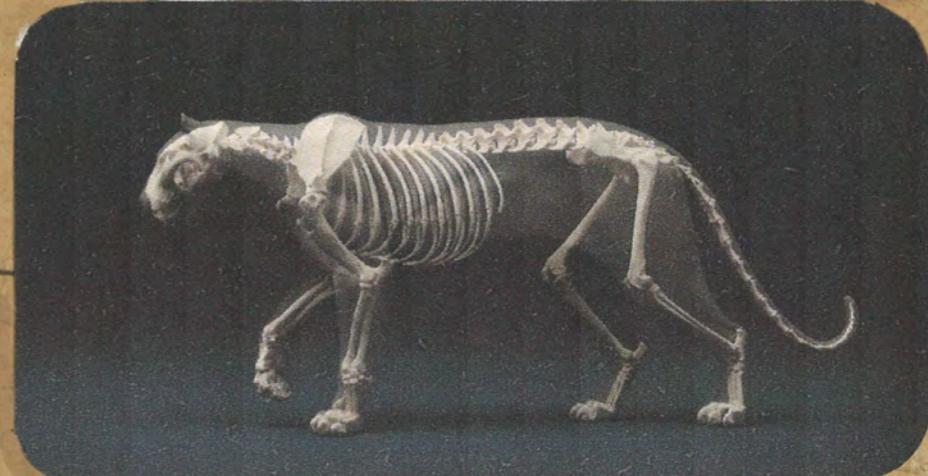
Joints?



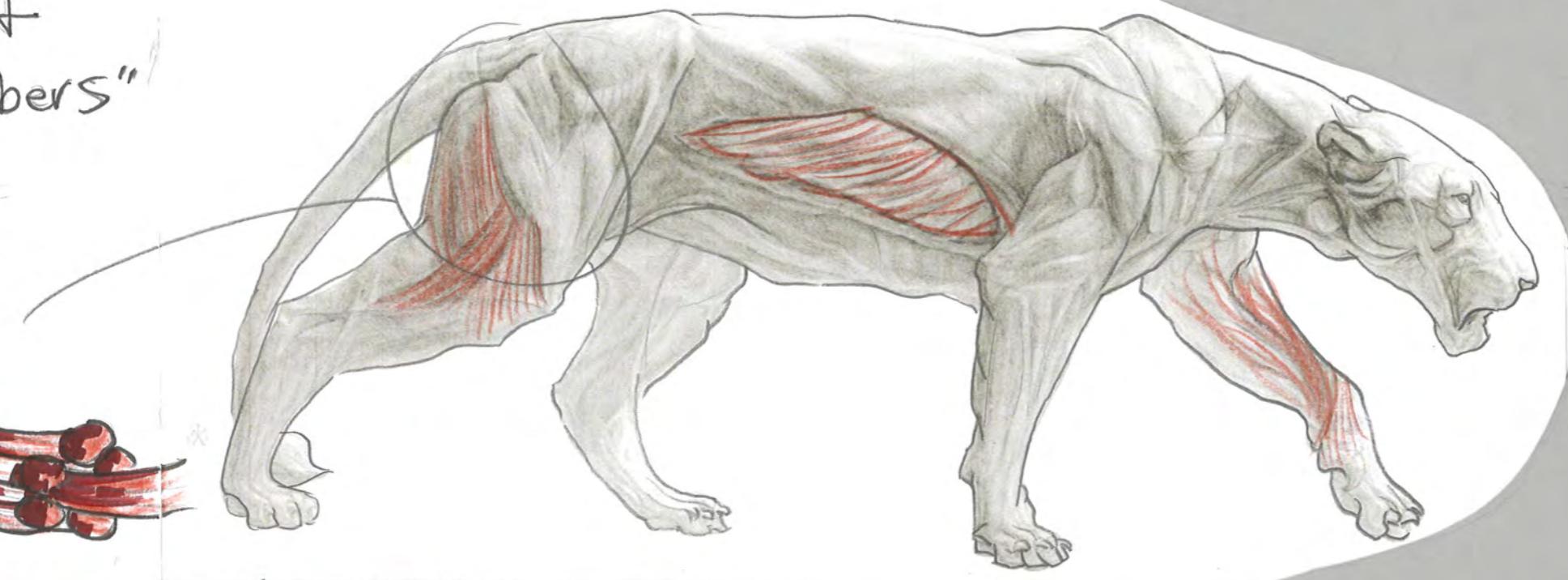
ANATOMY STANDARD



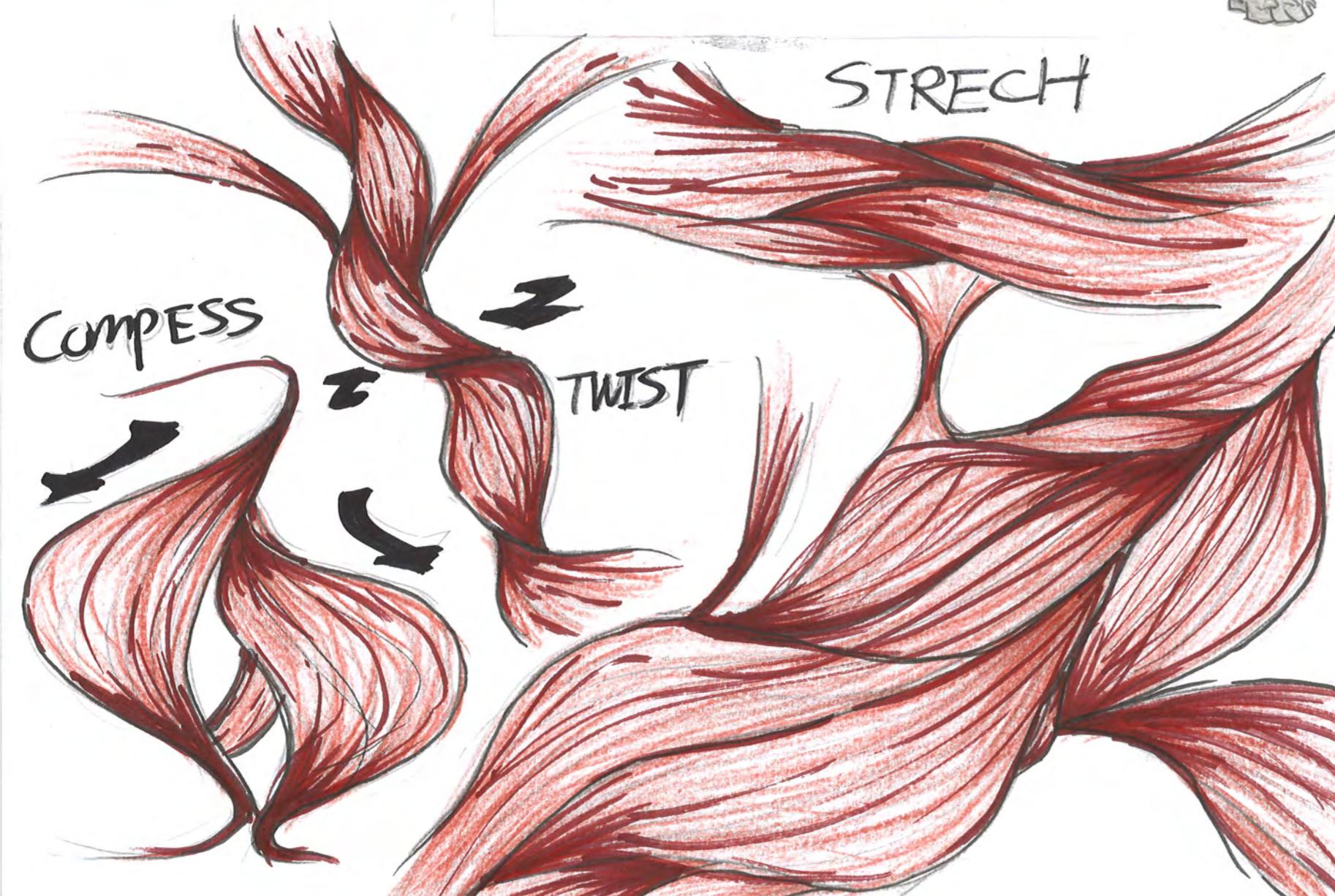
Connect?



Muscles are
made up of
"Muscle Fibers"



FORMS



LEOPARD ANATOMY



IDEAS

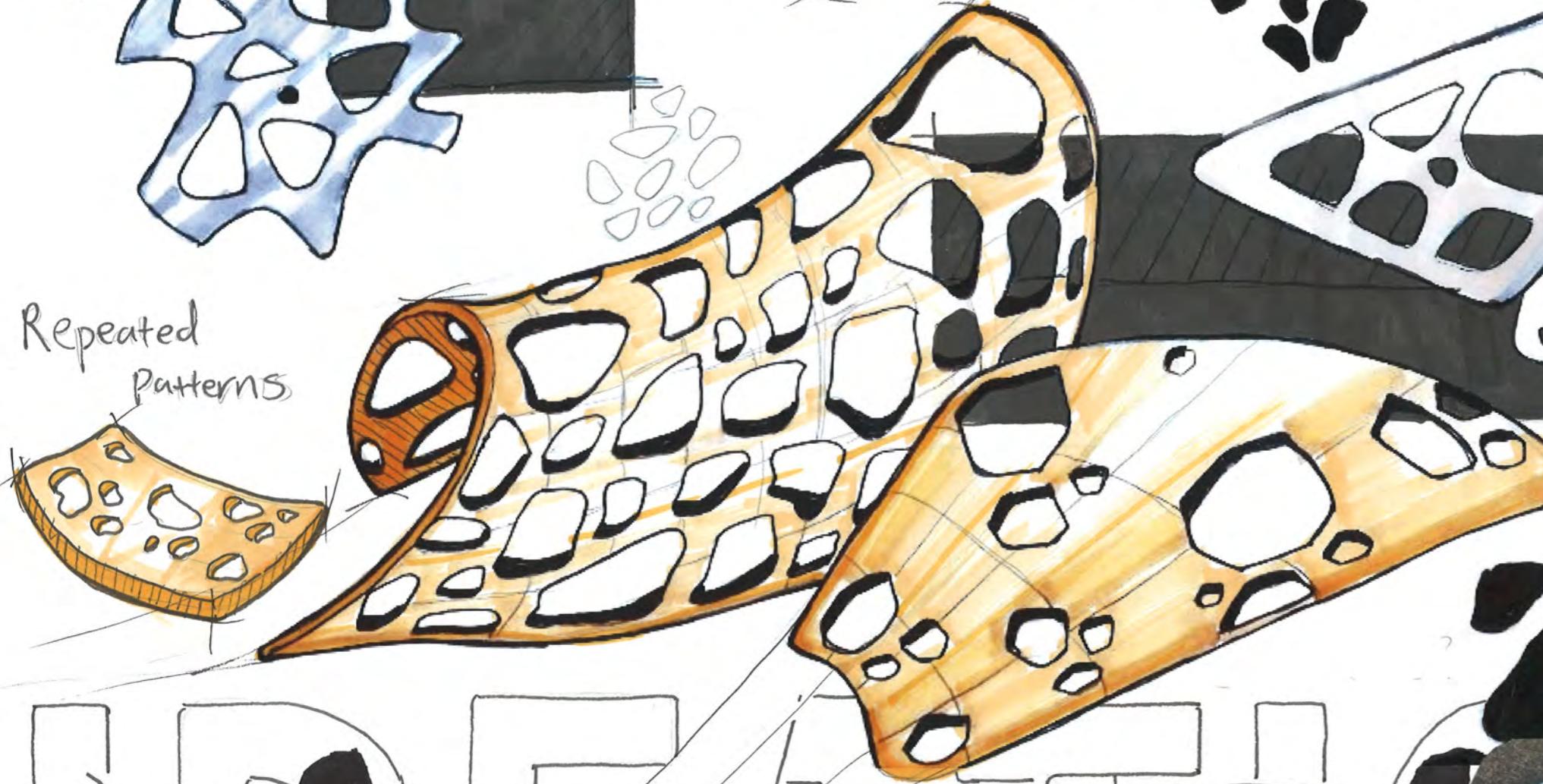
EXPLORING PATTERNS INTO STRUCTURE



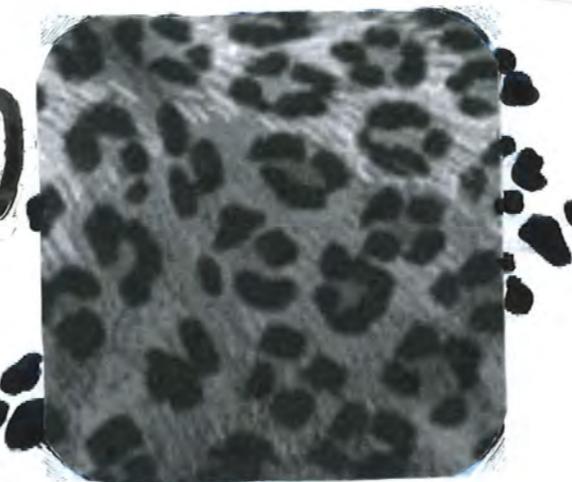
Like sponge?



Repeated Patterns



I D E A



Or ONE BIG,
Two small



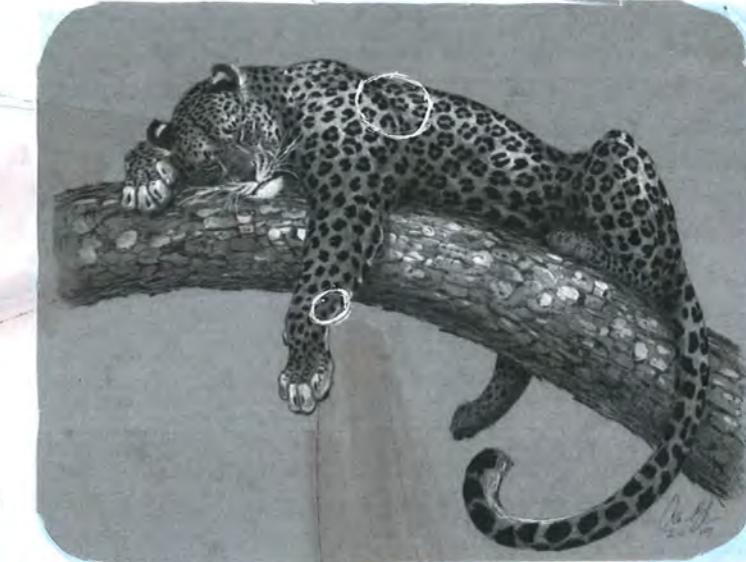
Any Rules?
One Big,
Three Small.

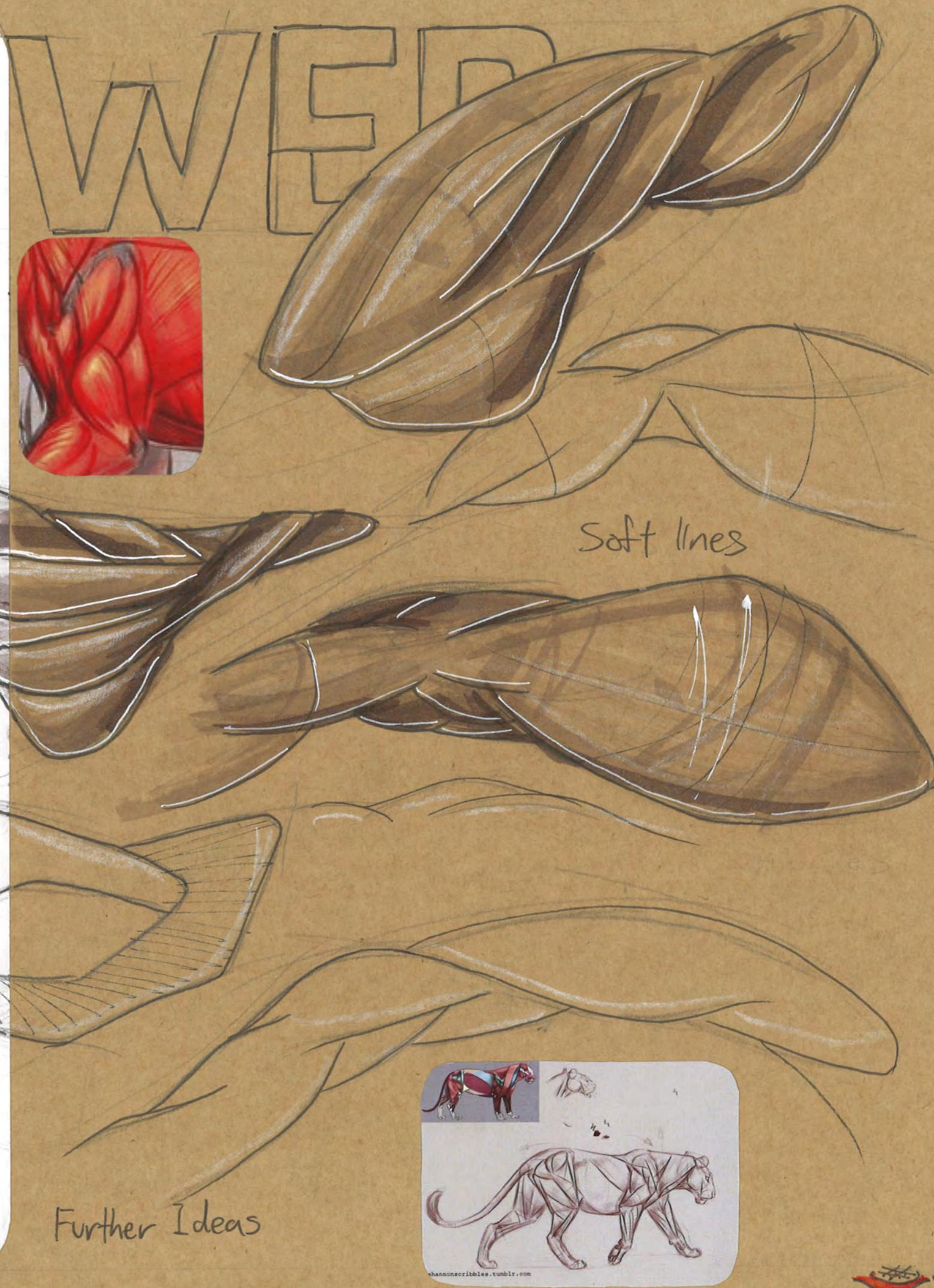
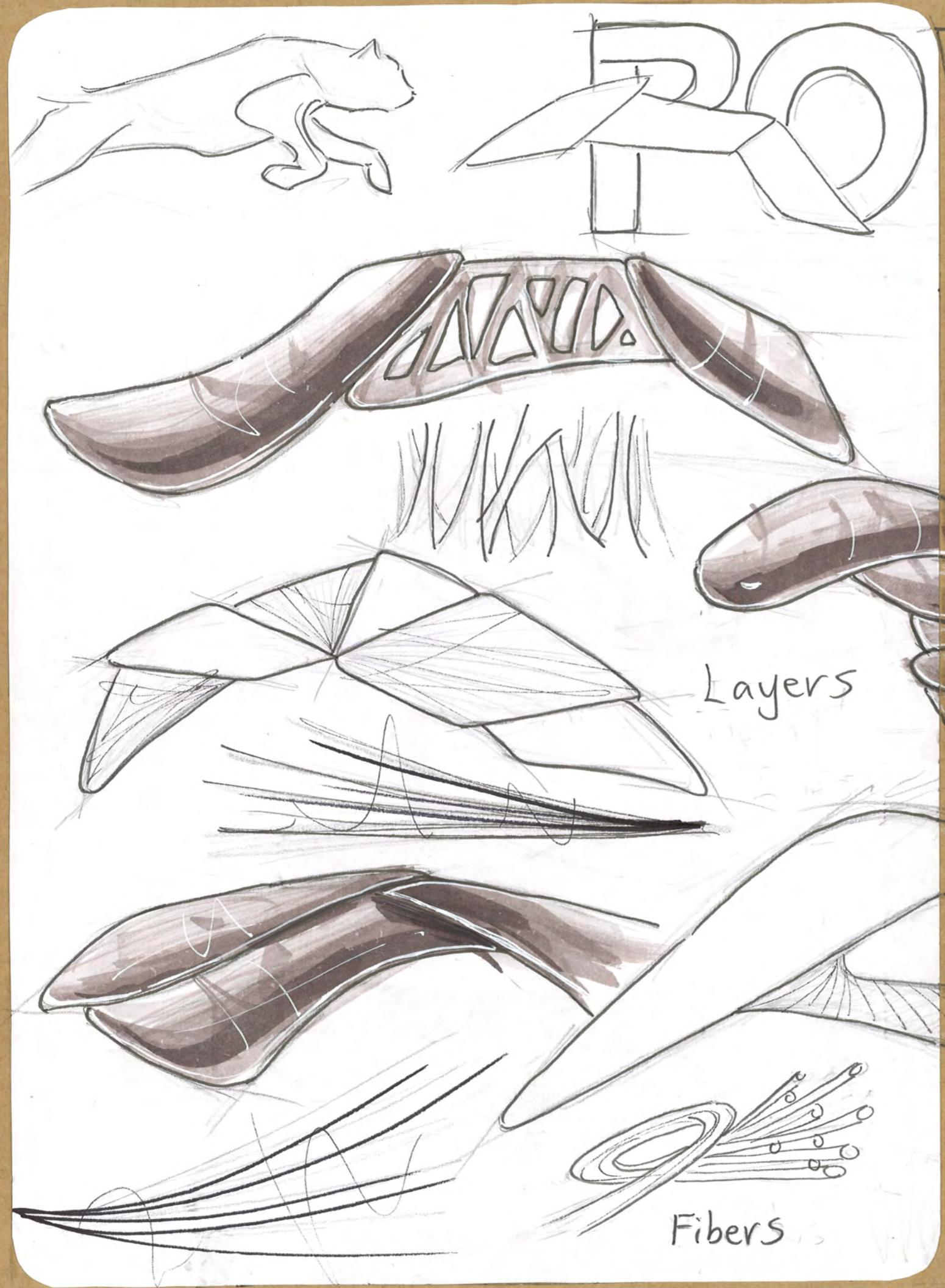


Like Sea-Coin 5?



Same patterns?





CHEETAH

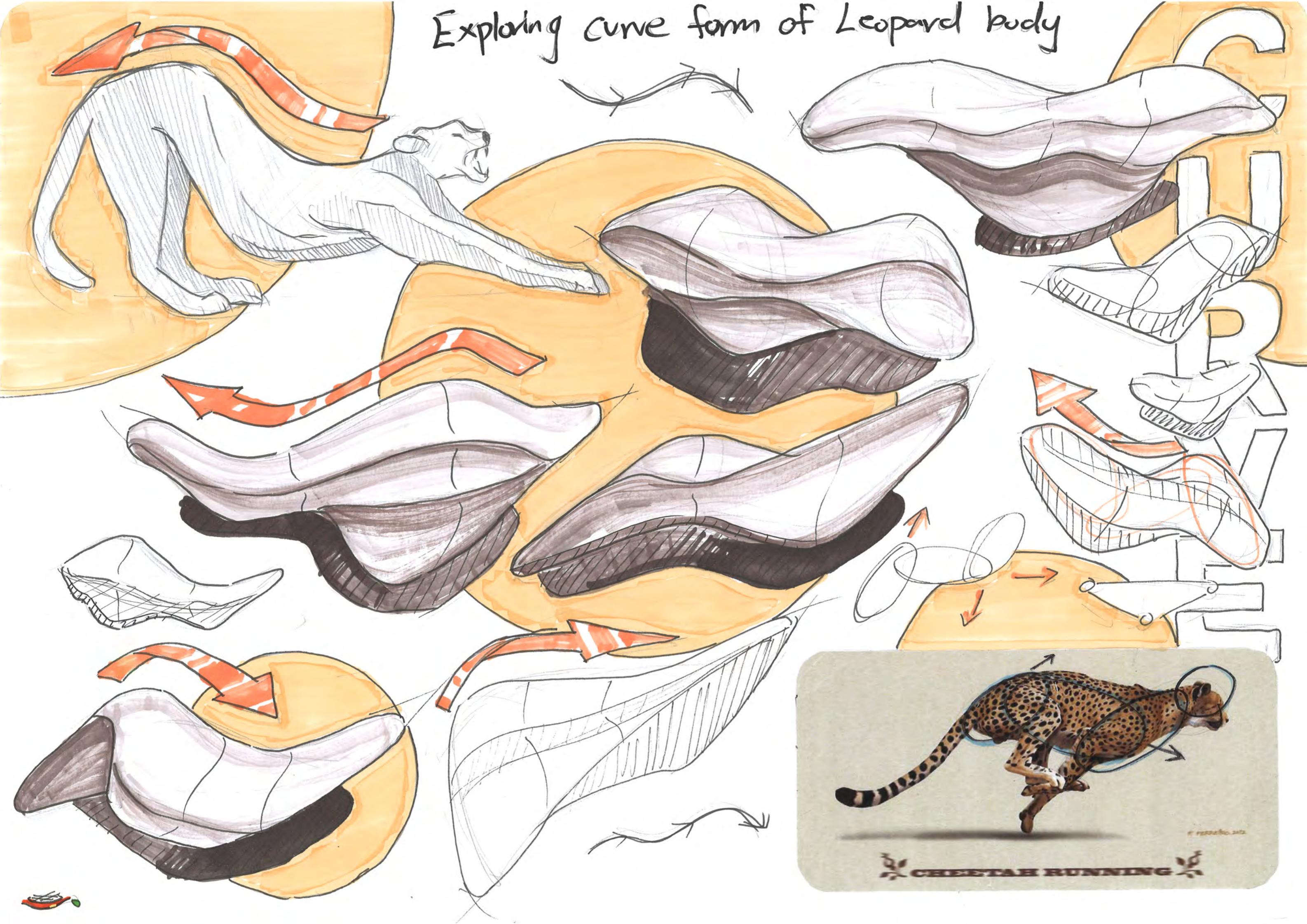
Acinonyx jubatus

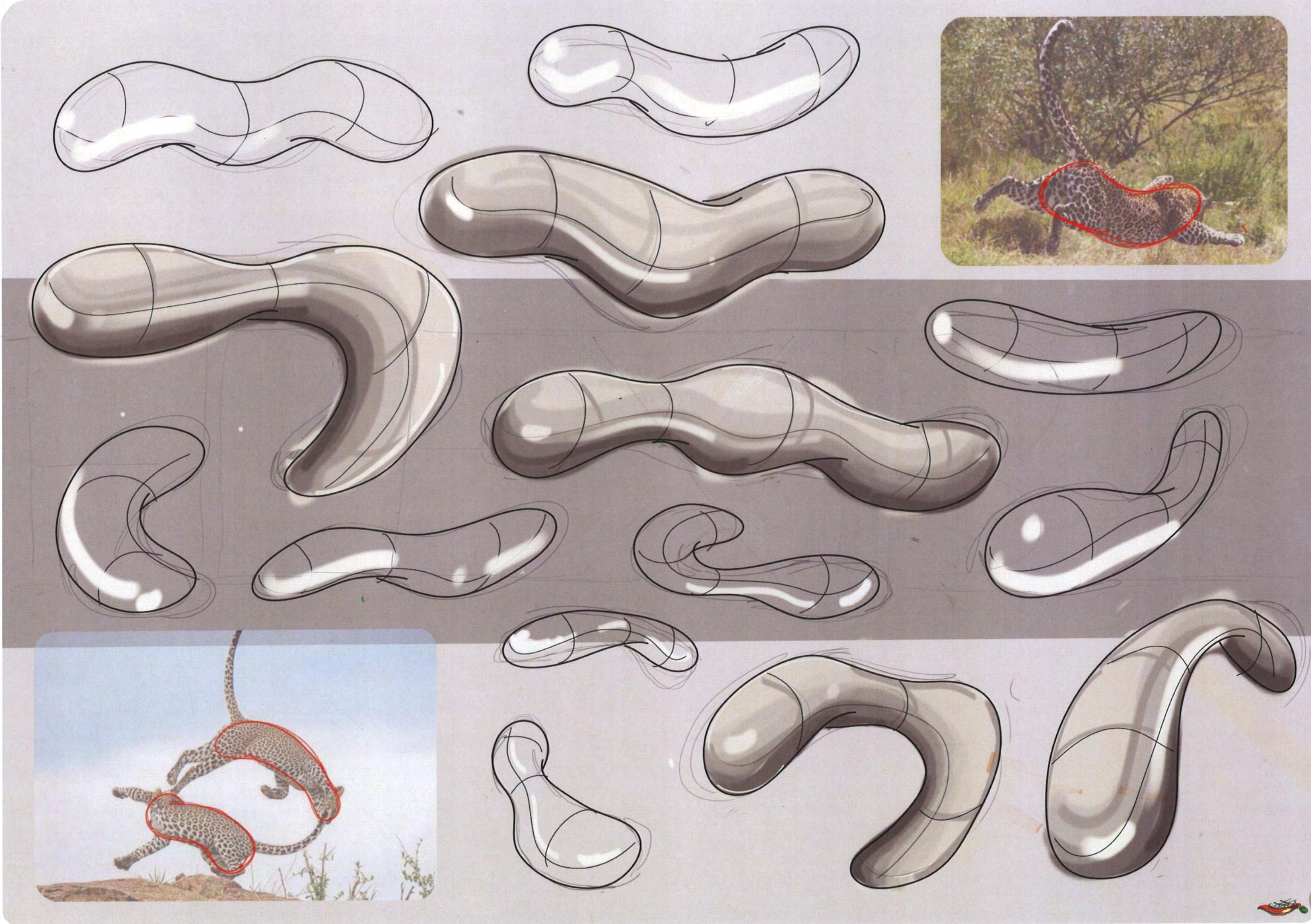


Exploring the Body Lines



Exploring curve form of Leopard body





Design Brief

Situation

Cycling has become a very popular sport. There are all different sorts of bicycles for different types of cycling sports. From beginners who as new cyclists facing challenges of deciding what type of bicycle they will buy, to experience sporting enthusiasts wanting the latest state of art superbikes. Technology is advancing at a great pace allowing almost futuristic bike designs. It is my challenge to try and design one of these modern-day bikes.

Brief

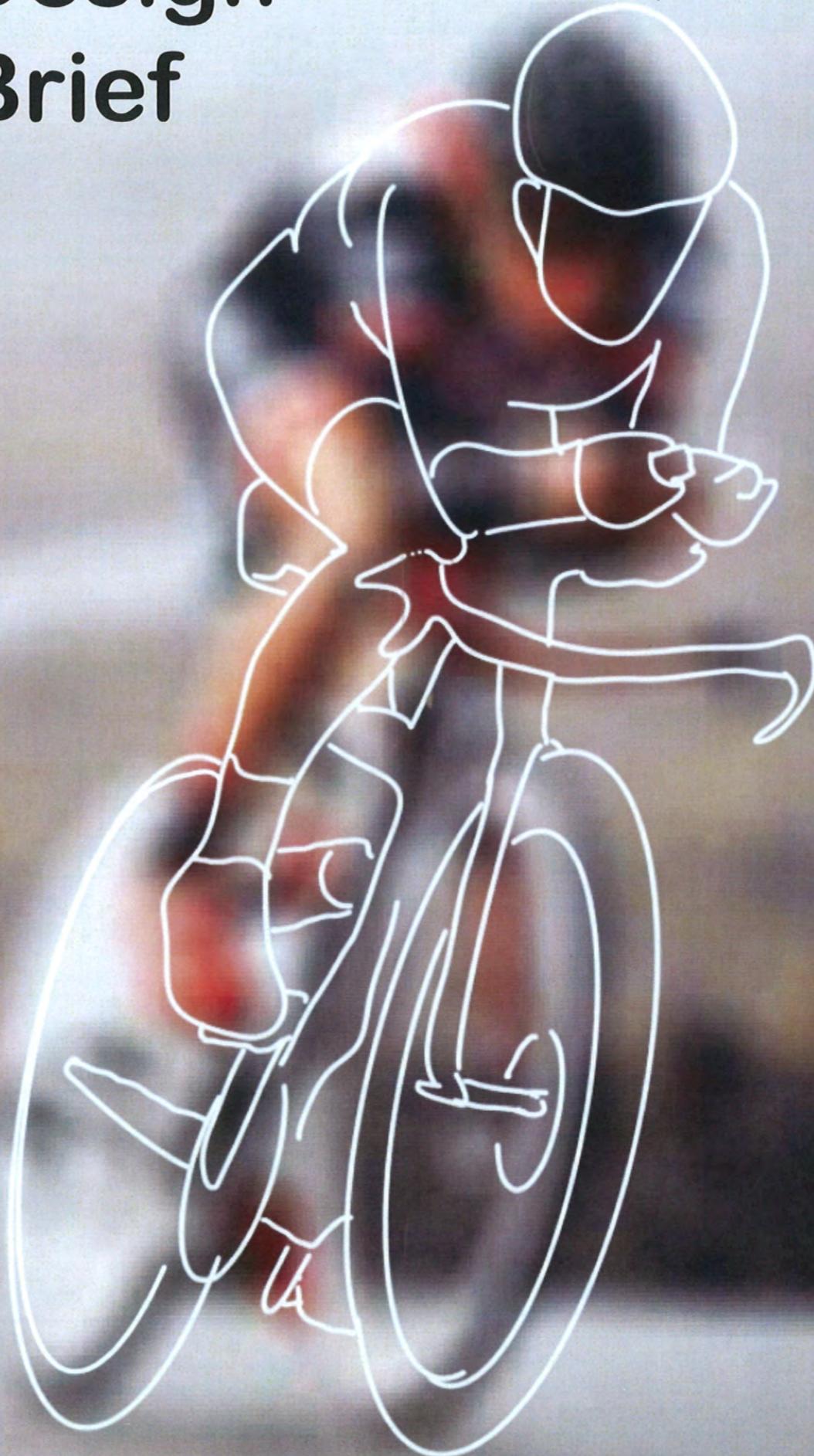
To design a multi-purpose (mountain and road bike) that uses modern technologies for construction, performance, durability and sustainability.

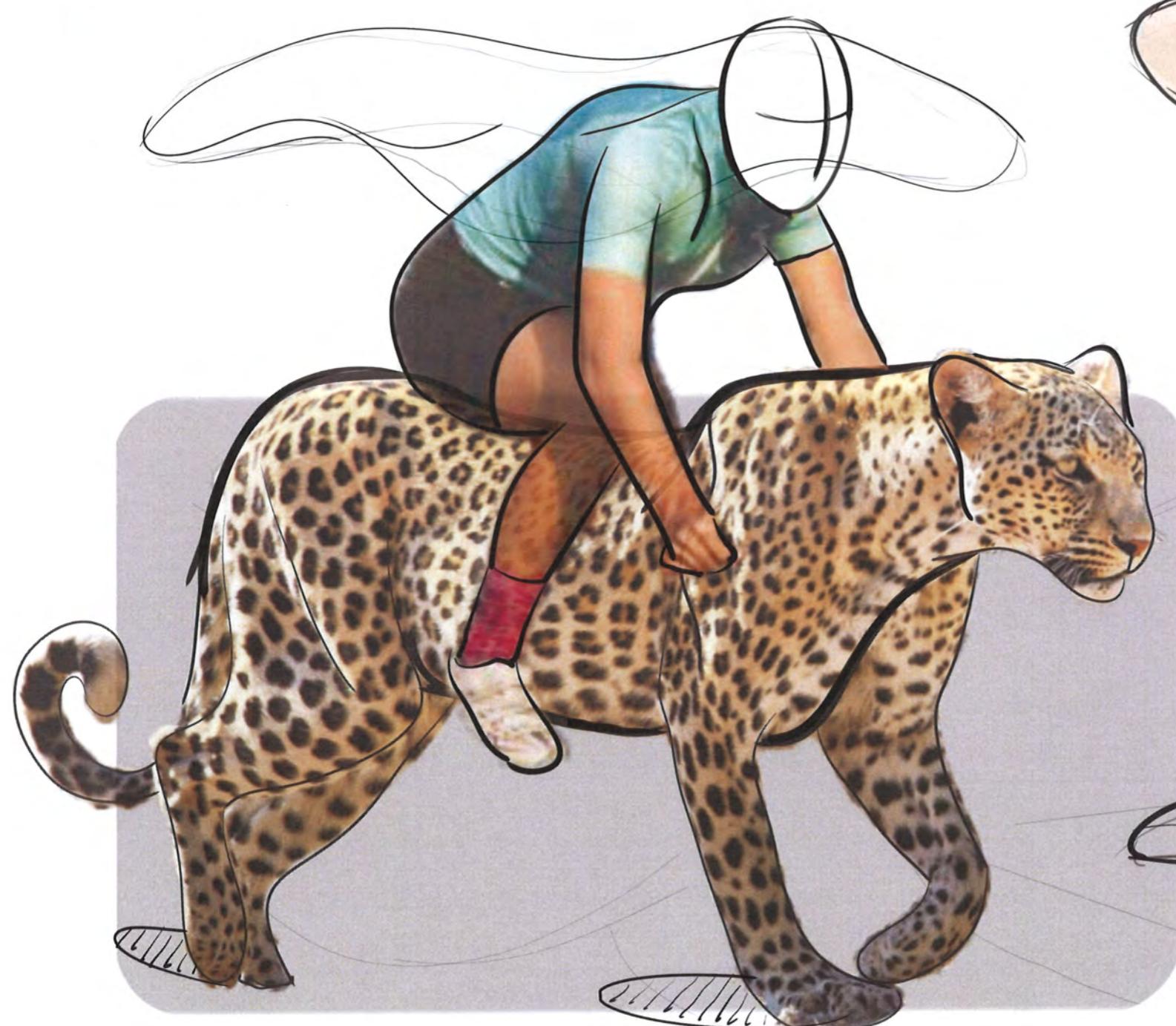
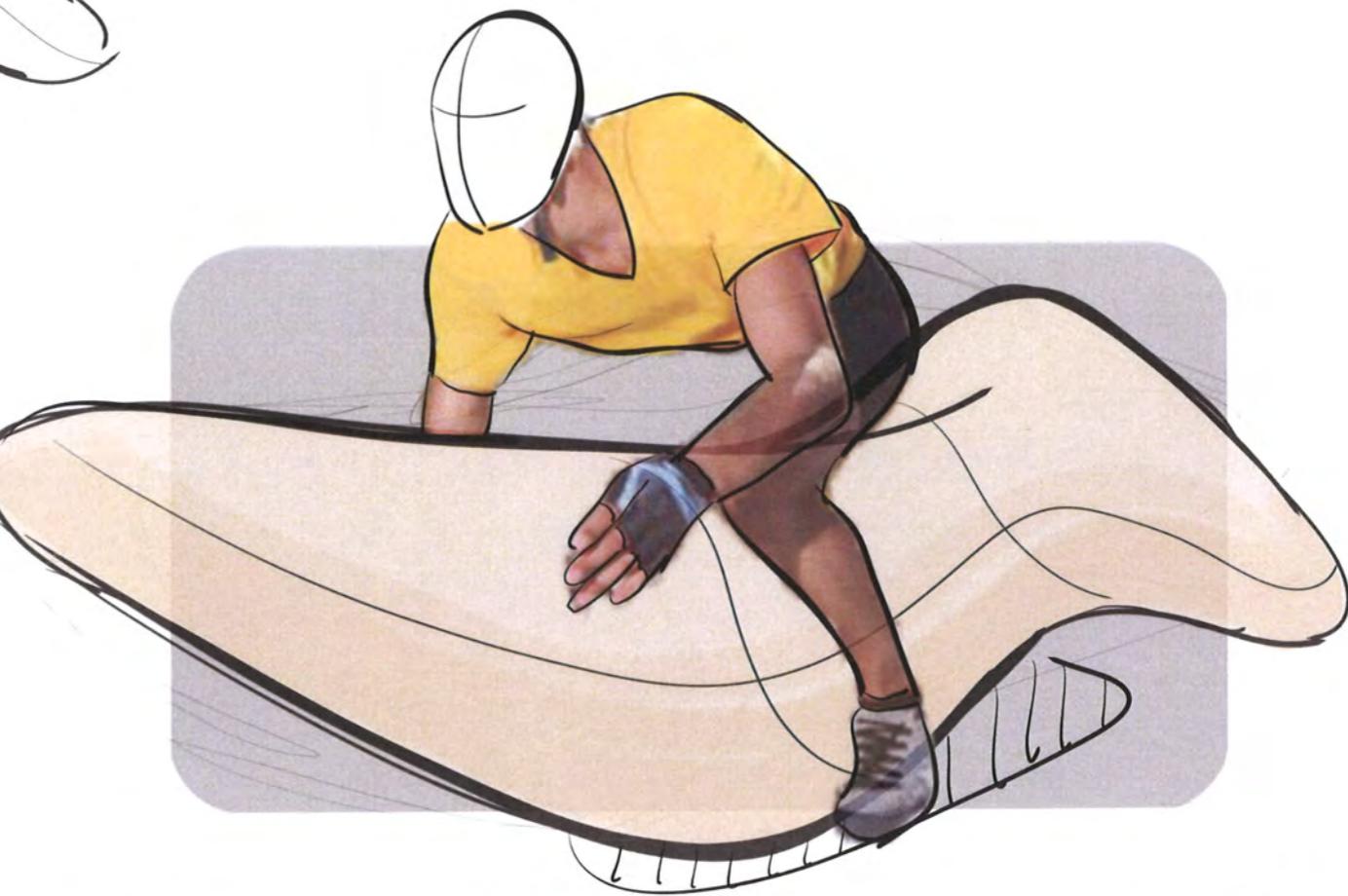
Specifications

- Unique appearance that contain modern aesthetics appeal.
- Sustainable in different environment (mountain/forest/road)
- Considering the size and comfort on ergonomics.
- It will be light, fast and aerodynamics
- Durable and Stable (high strength materials and joints)
- Safe in slippery ground (anti-skid& sensitive brake)
- Safe for night-time cycling (head light & reflector)
- Stable and smooth riding experiencing
(Shock absorber & Suspension)

SSS

- Speed
- Stability
- Safety

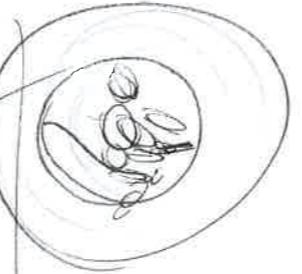
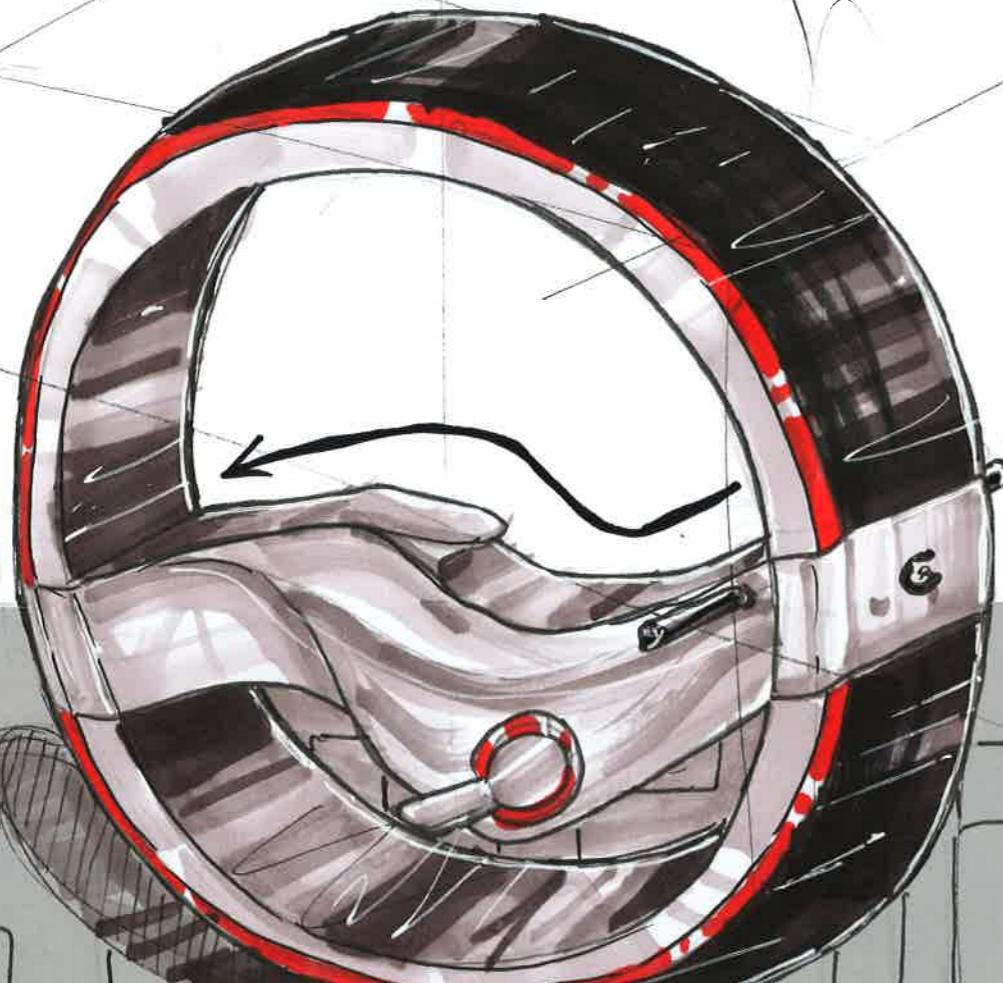




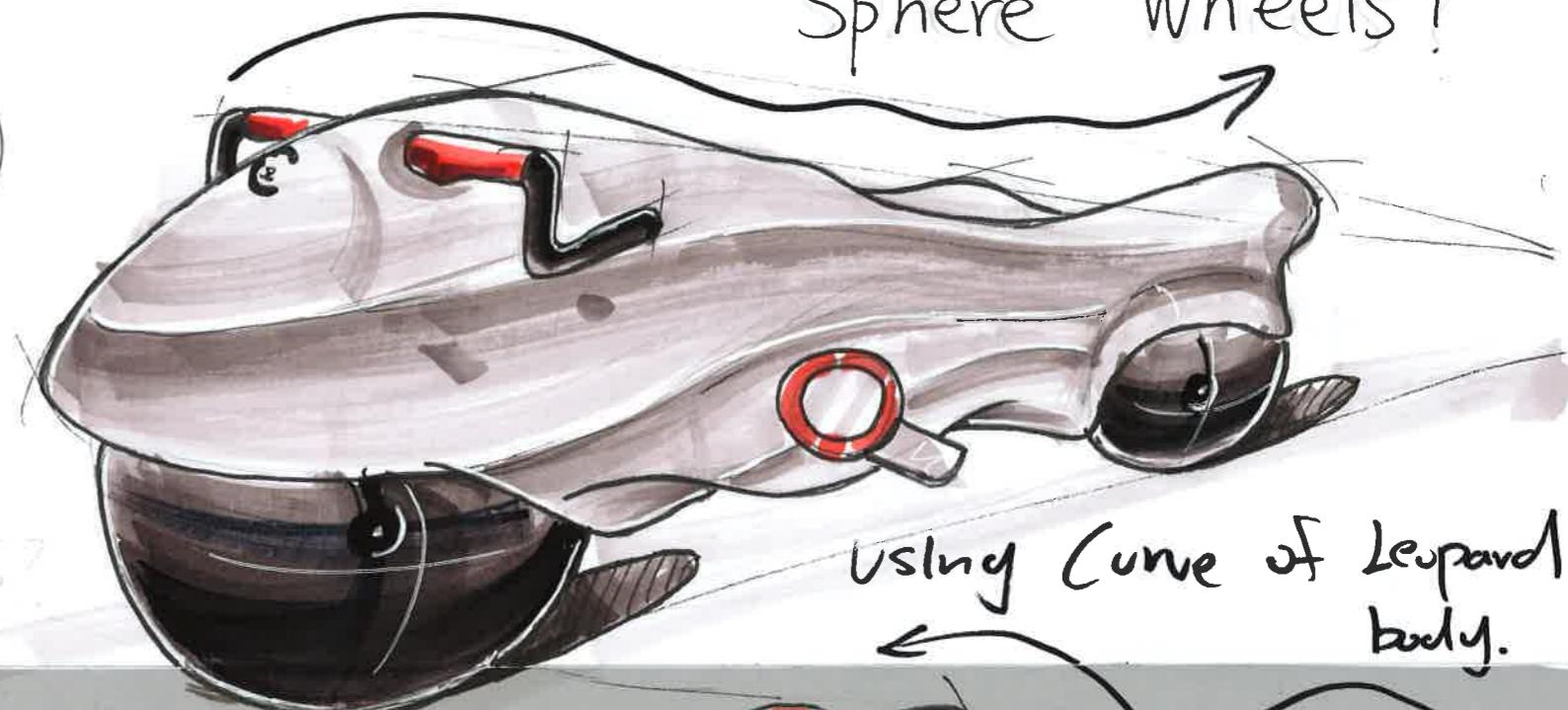
Like riding a leopard?



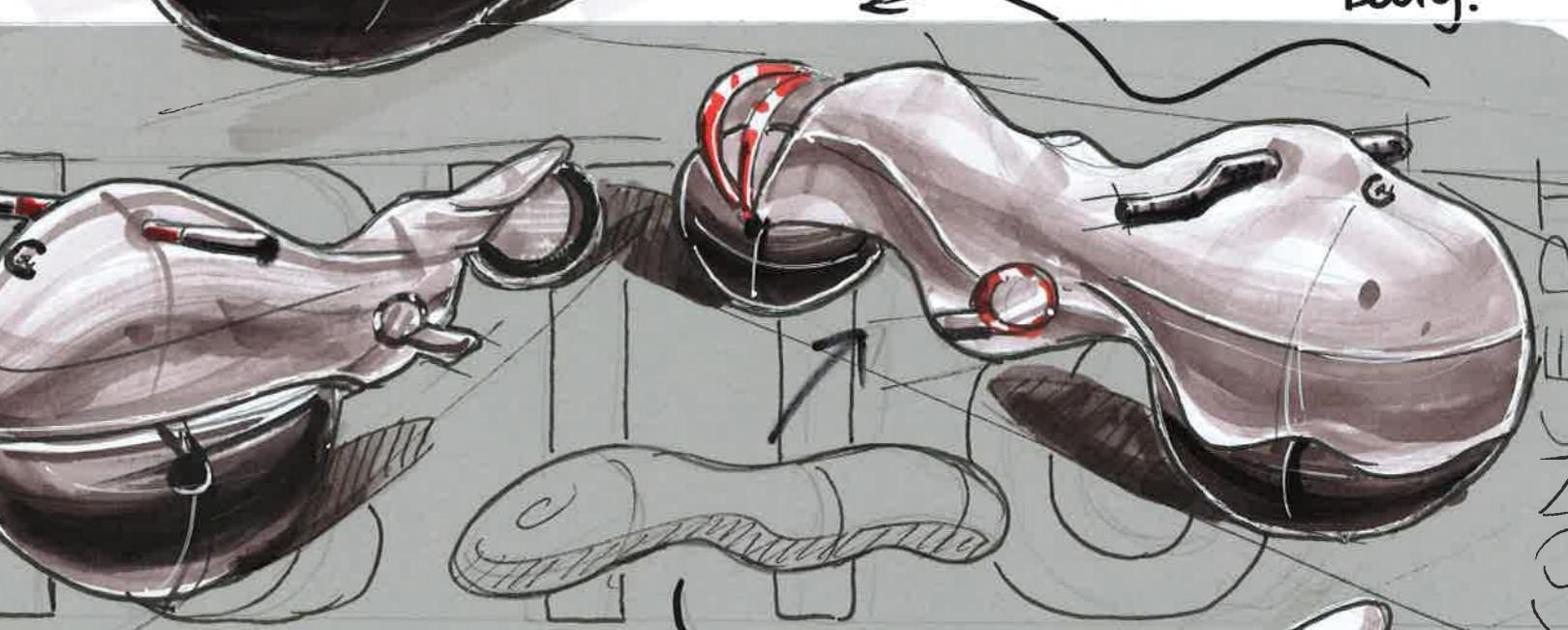
Futuristic Bike Concept



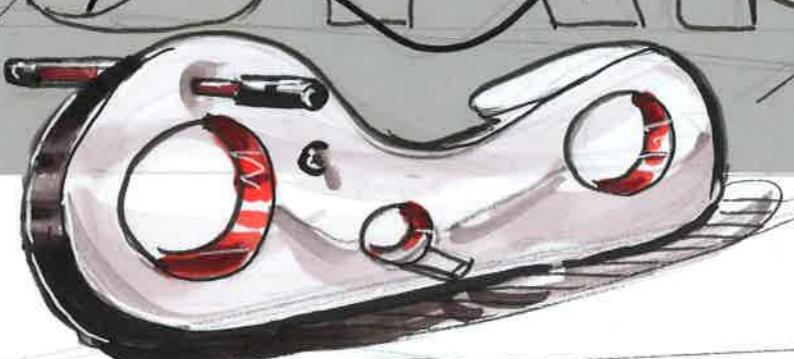
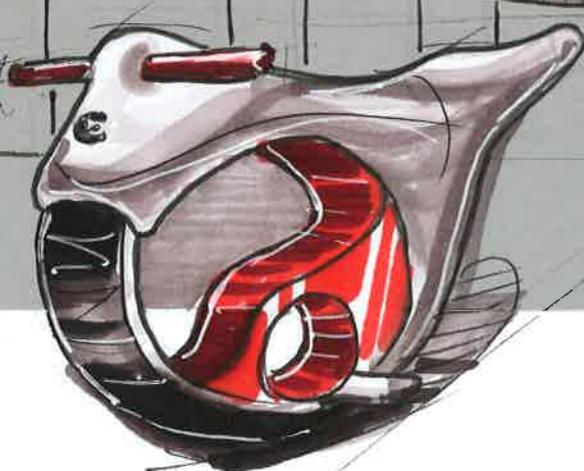
Single
Wheels?



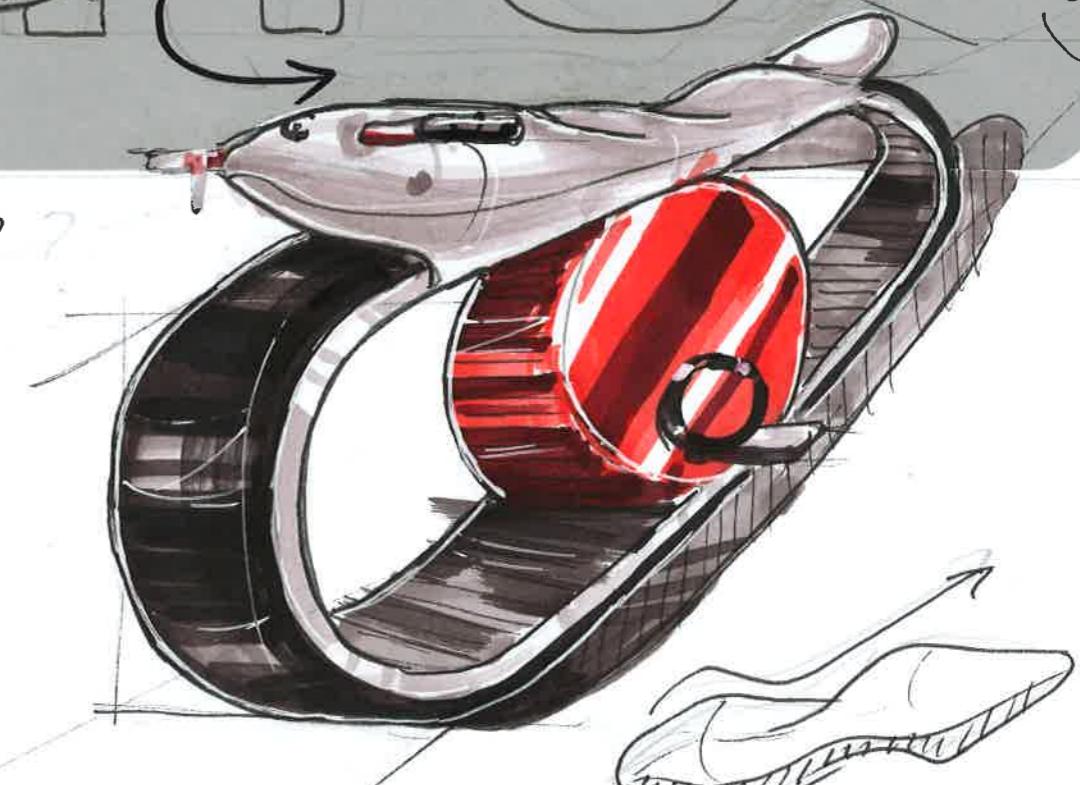
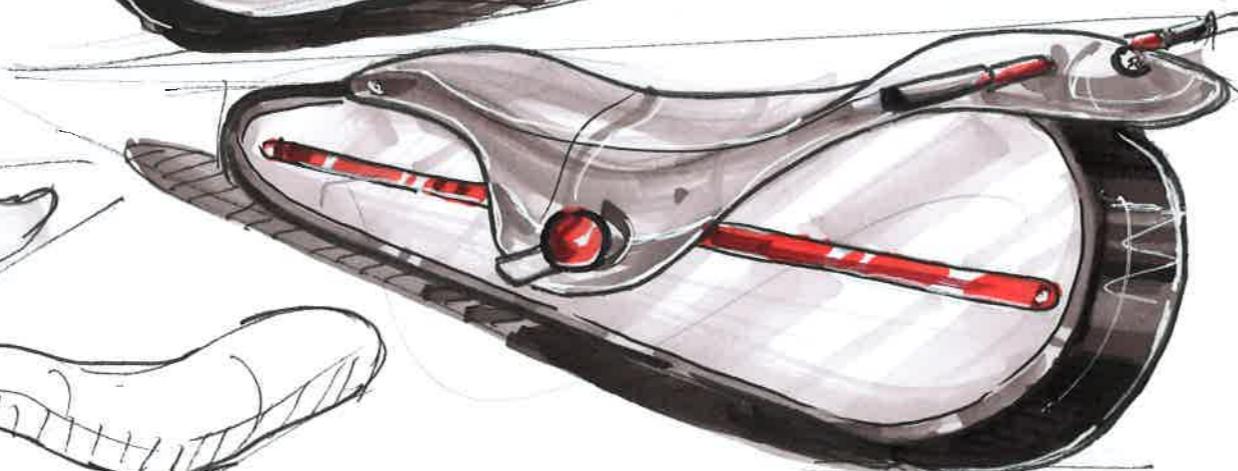
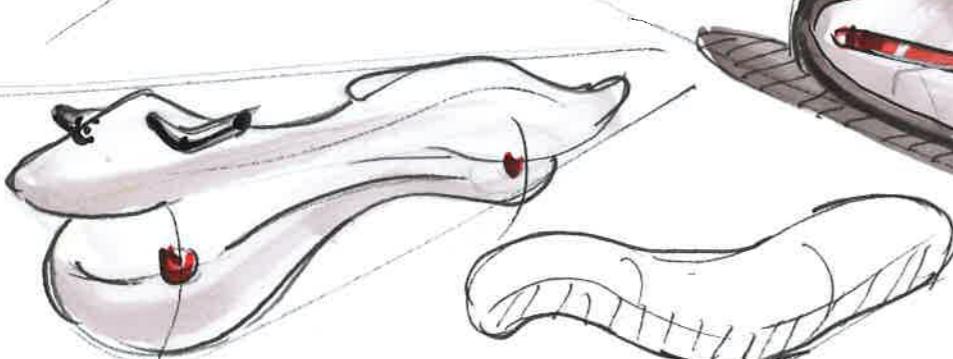
Sphere wheels?

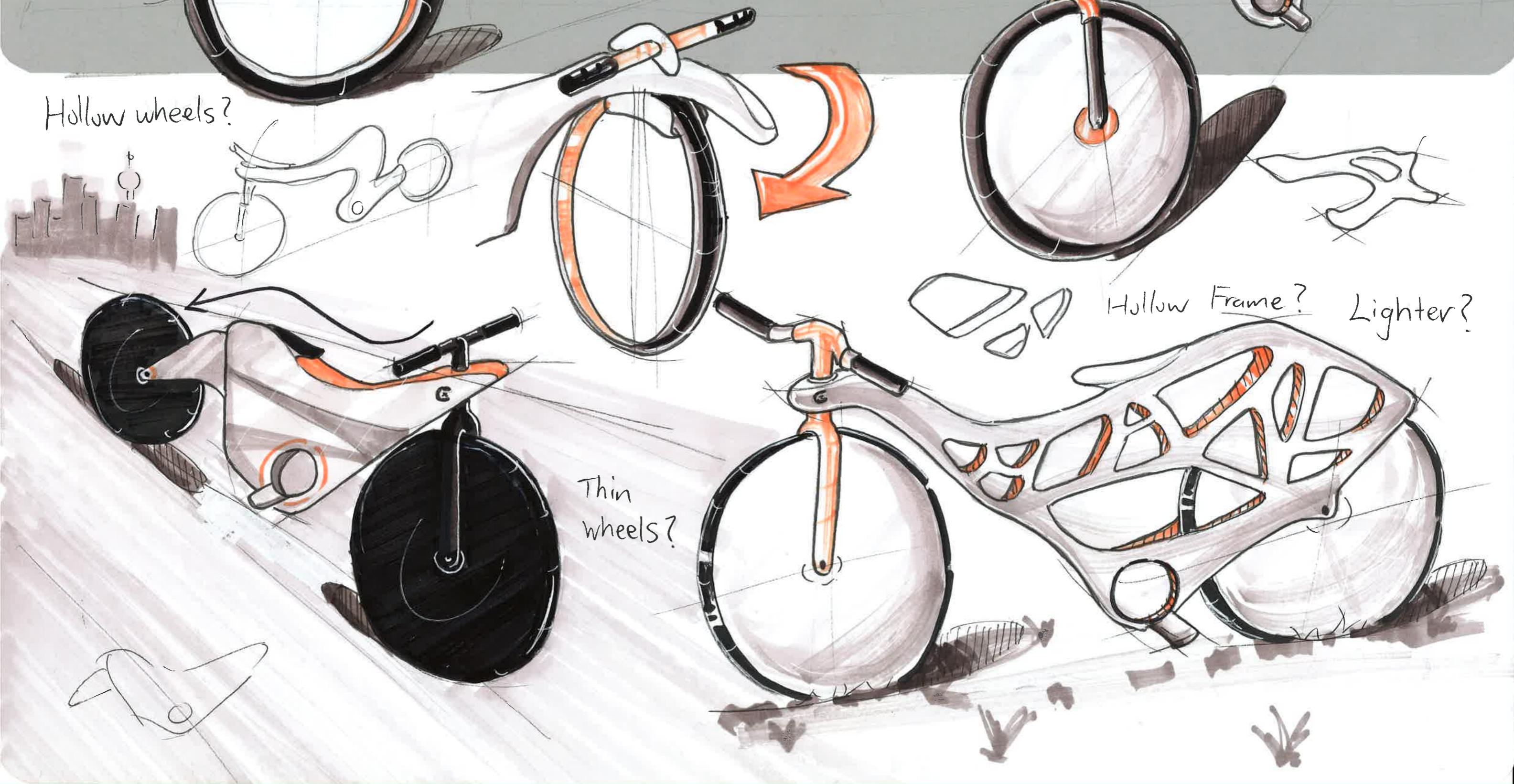
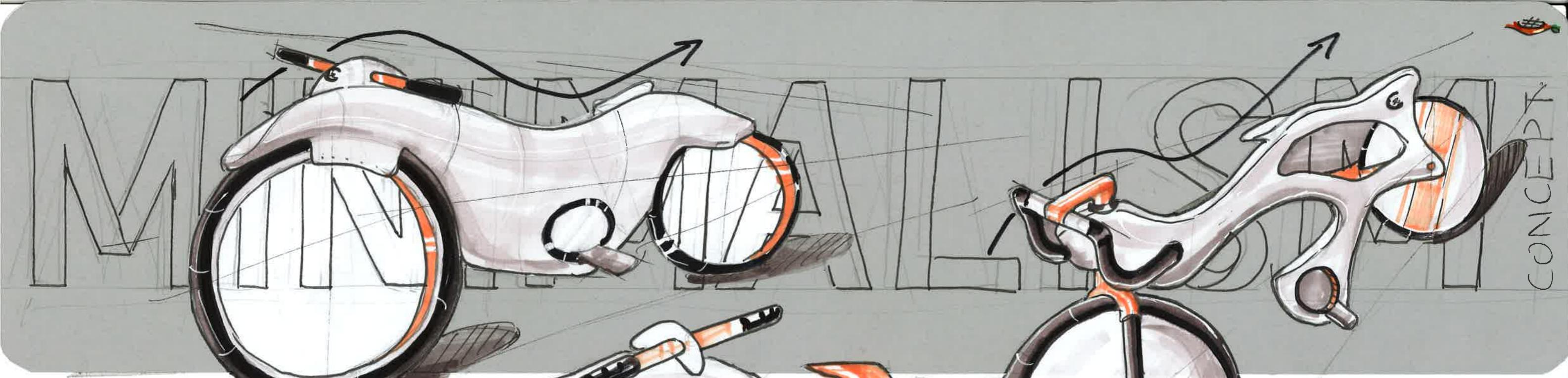


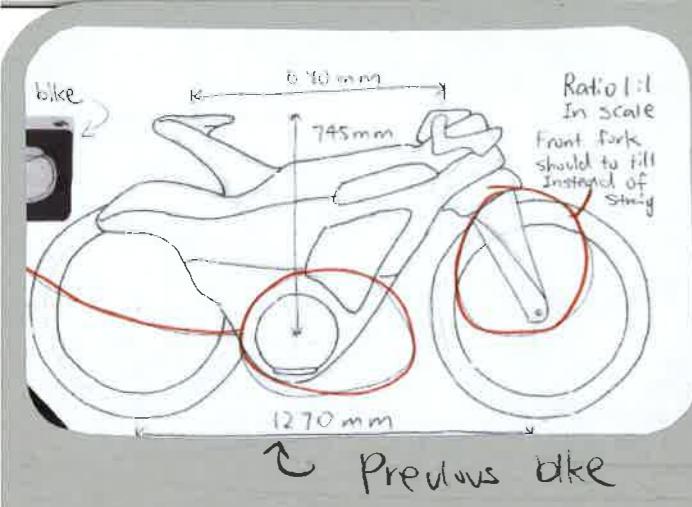
CONCEPT



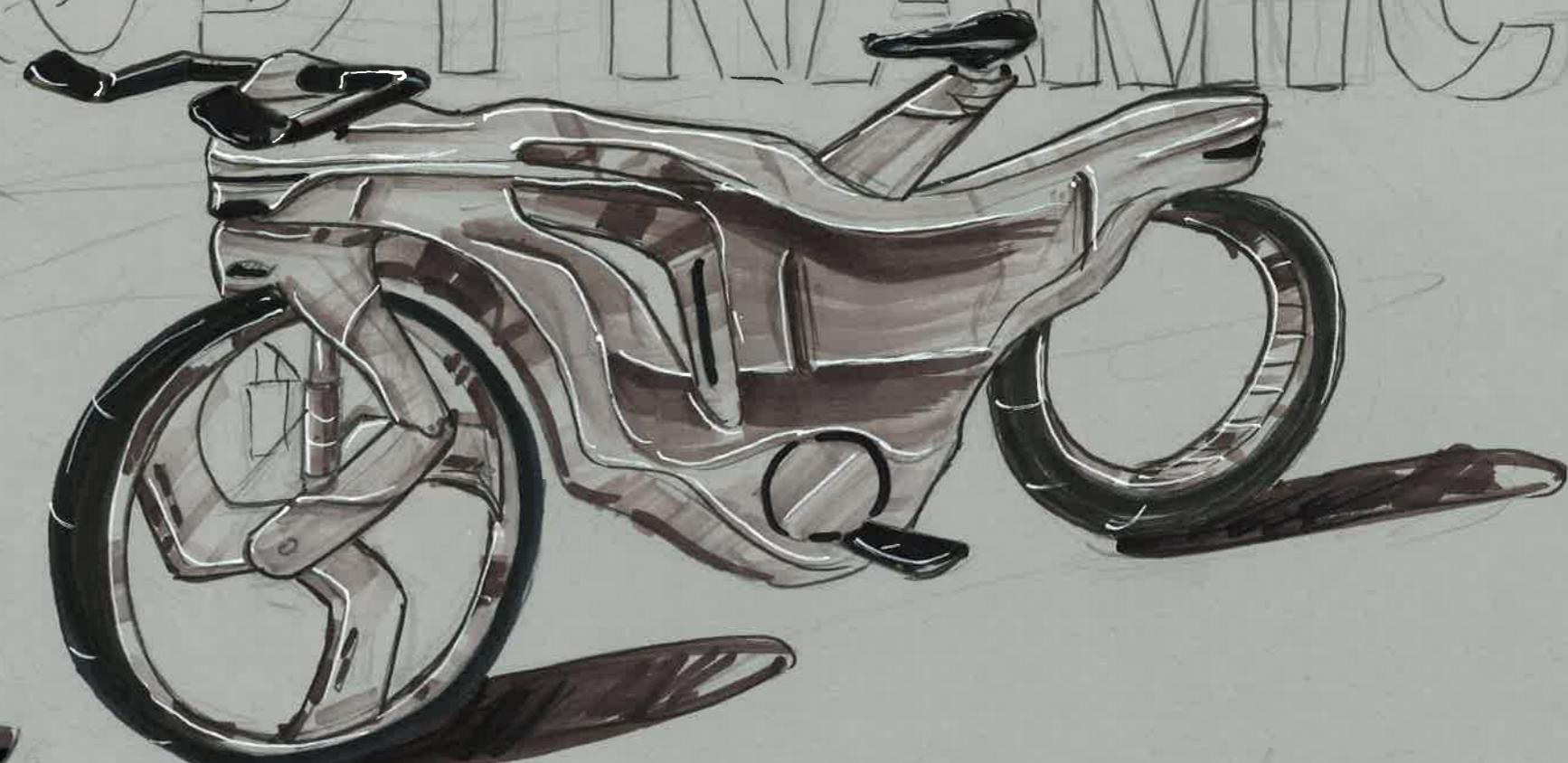
NO Wheels?





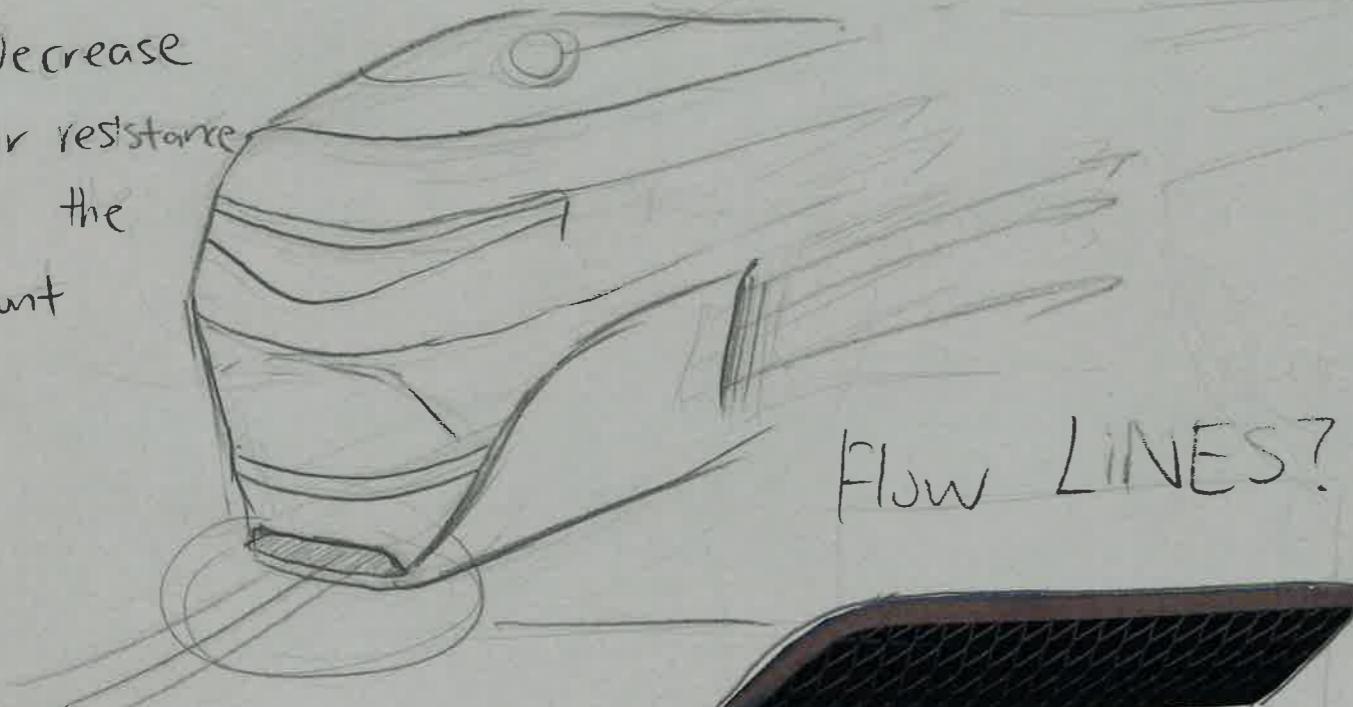


AERODYNAMIC



Decrease
Air resistance
In the
front

Flow LINES?



Allow Airs
flow through

Leopard body Lines



Air will push bike down
Increase down Force

DYNAMIC

FORM?

All edge is
rounded

Increase
down
force

Air more easier to flow through

Safety is the priority on the road:

The death in bicycle accident has increased 30% in the past 10 years. According to the data from national center for heath statistic, there is 1024 bicyclist death in 2018, and 682 of them died in motor vehicle crashed.



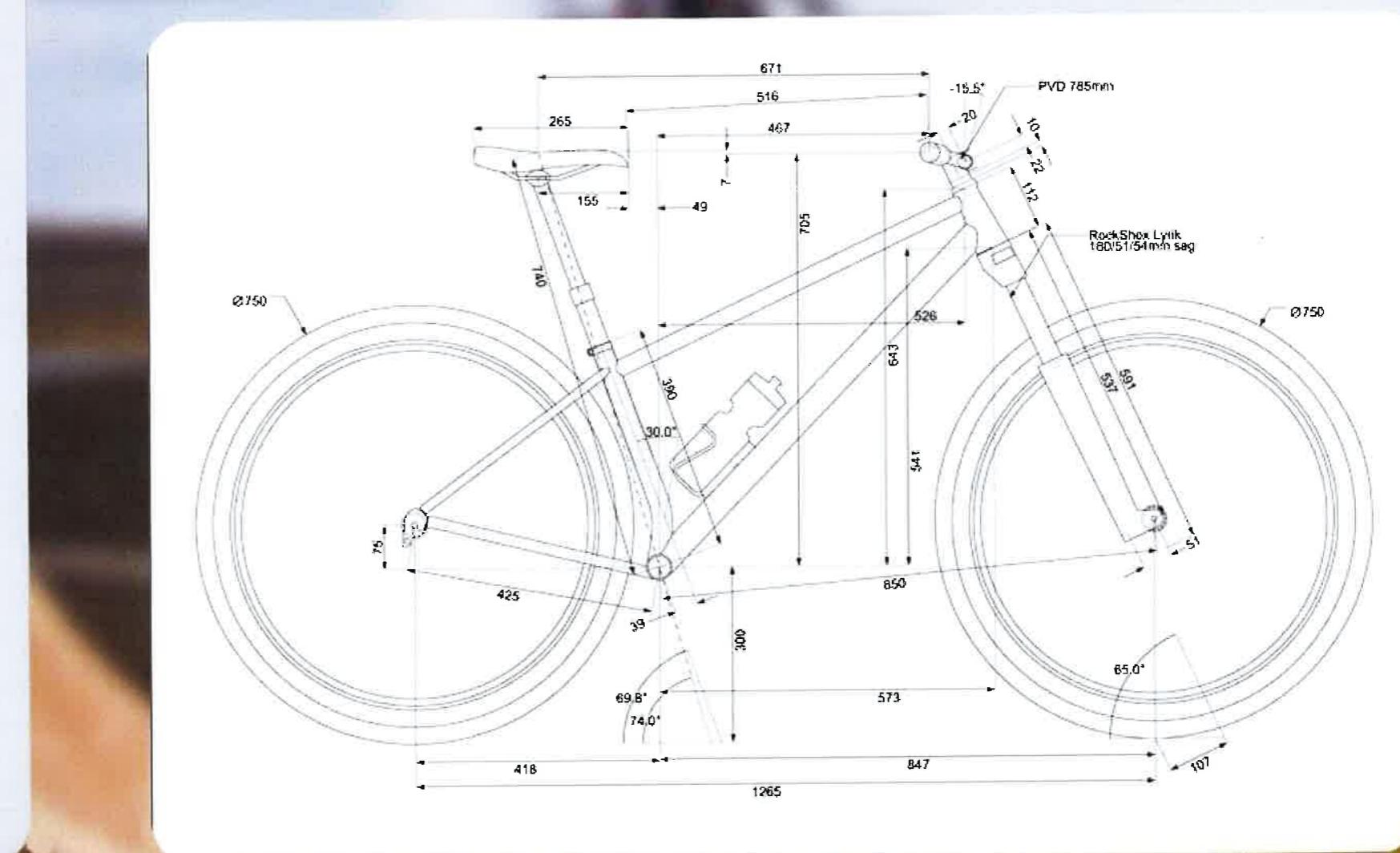
- Car crash are the major reasons cause bicycle accident, biking without a good front and back light will cause other road users not able to see the cyclist easily, especially in raining day, foggy day or nighttime. This will put the cyclist on risk of accident.
- High humidity in winter and raining day will cause a decrease in visibility. The cyclist will face a challenge of the handlebar and pedal will be more slippery. There will be less friction between the road and the tire, reduced the grip cause the bike more difficult to control.
- A heavyweight bicycle will take more energy of the cyclist in long-distance biking or climbing up on a hill.
- Incorrect size bike and uncomfortable seat for cyclist in long-distance travelling might evoke neck pain, back pain, or knee issues.
- The danger can come from the road itself, riding in a poor state road with potholes will cause a serious issues. Passing through the potholes with a high speed might cause a danger to the cyclist.

What issues is cyclist facing?

Ergonomics

Ergonomics is concerned with the fit between the user, product, and environment. It is necessary to prevent repetitive strain injuries and make the user feel comfortable using the product.

During the cycling there are five-point contacts with the bike; two grips, two pedals and the seat. The height of the seat determines the strain on arm and wrist, also the pedal efficiency. The most suitable height of the seat should be slightly higher than handlebar and allows; the arm and wrist on the minimum pressure, the knees coming parallel to the ground at their maximum height, and the legs should be just straight at the bottom of the loop of the pedal. A full rotation on pedal should be easy, comfortable and natural, while keep the center of gravity over the middle of the bicycle. The body should be approximately 15 to 30 ° angle to the horizontal, and 90 ° to the arm.





Greg Lemond Method:

Saddle height formula:

Inner leg length

multiply by **0.883**

Is the distance from
Centre of pedal circle
to the seat.

If adjust
seat height
by a pivot

$\times (0.883)$

Rider height Feet/inches	Centimeters	Leg inseam Inches	Centimeters
4'10"-5'1"	148-158 cm	24-29"	61-73 cm
5'1"-5'5"	158-168 cm	25-30"	63-76 cm
5'5"-5'9"	168-178 cm	26-31"	66-79 cm
5'9"-6'0"	178-185 cm	27-32"	68-81 cm
6'0"-6'3"	185-193 cm	28-33"	71-83 cm
6'1"-6'6"	193-198 cm	29-34"	73-86 cm

Graph shows relationship between height & Leg inseam

Too far

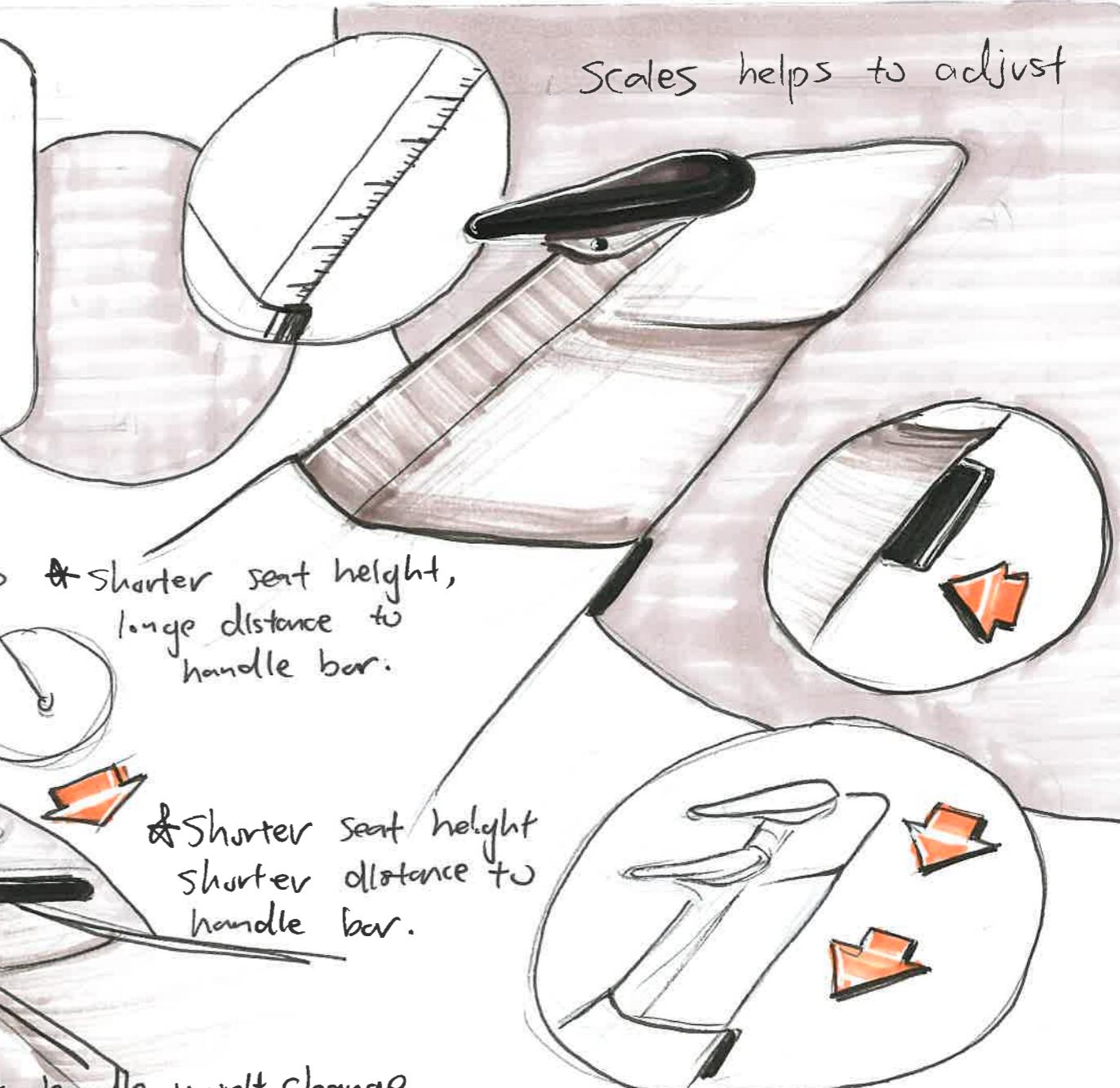
Will increase
distance
to handle

* Shorter seat height,
longer distance to
handle bar.

* Shorter seat height
shorter distance to
handle bar.

But if adjust it
by pushing down, the
relationship between seat & handle won't change.

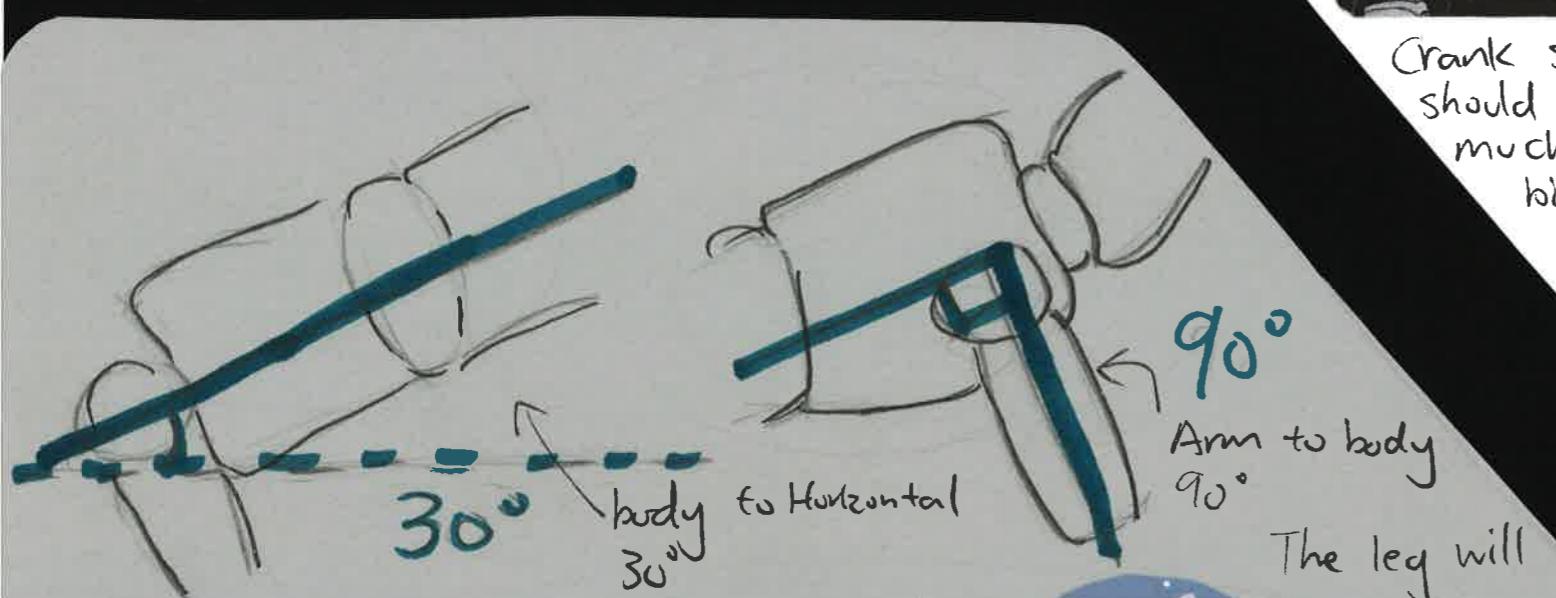
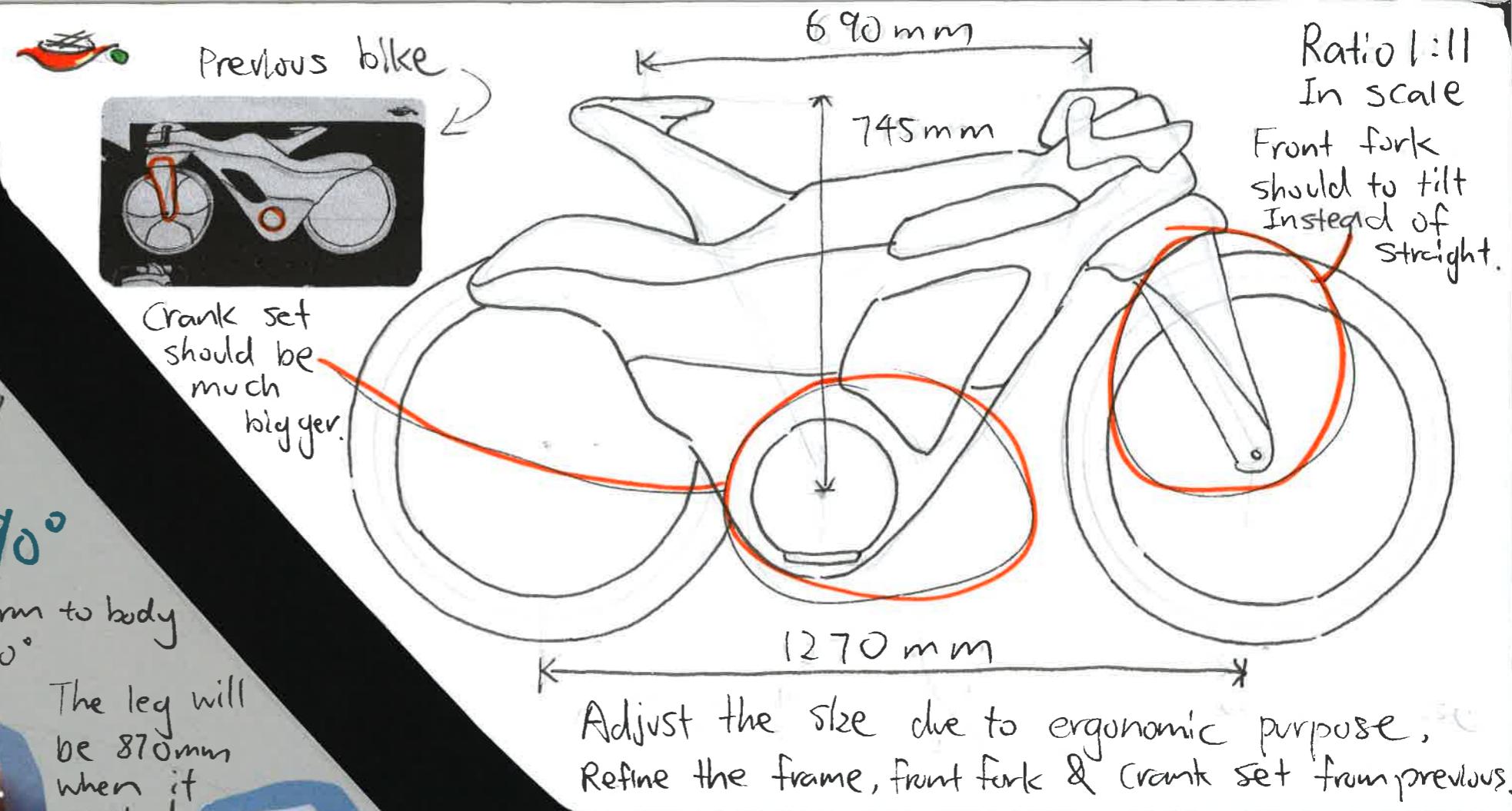
Scales helps to adjust



SADDLE
HEIGHT

DEVELOPMENT

Ergonomics - Body

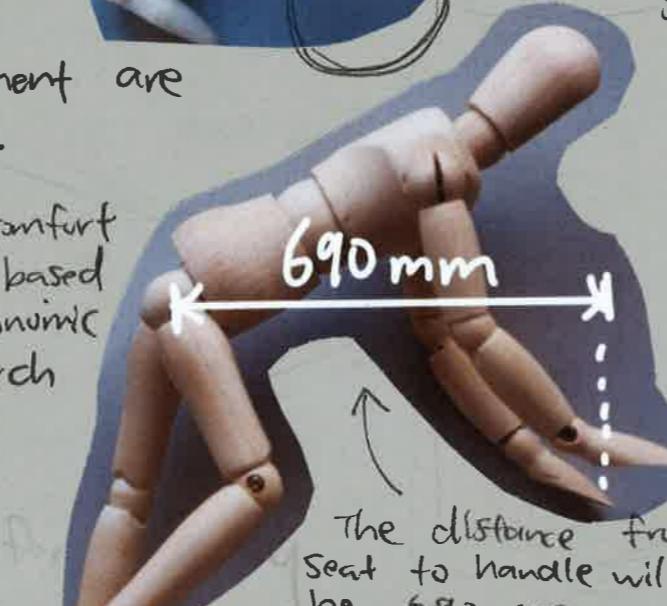
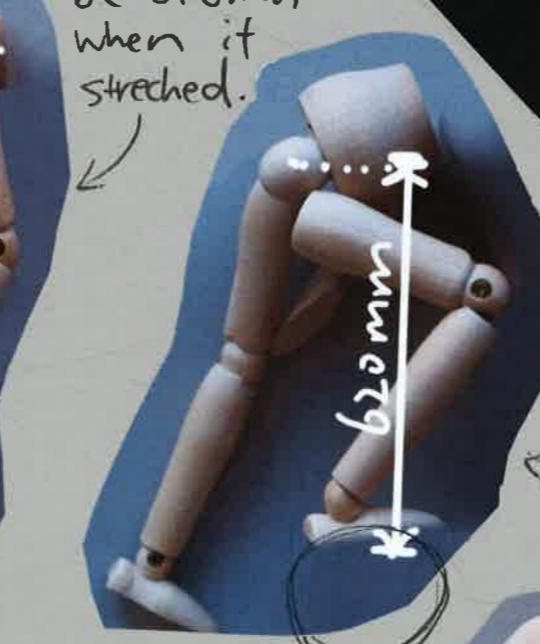
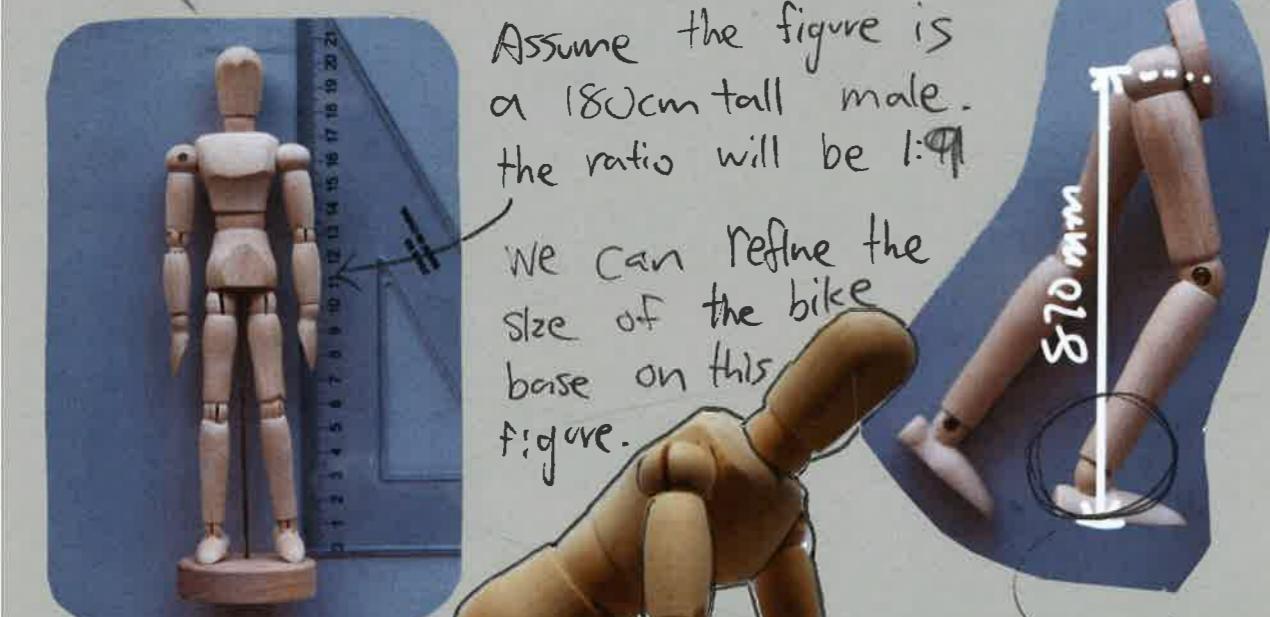


Assume the figure is a 180cm tall male. the ratio will be 1:9

We can refine the size of the bike base on this figure.

The leg will be 870mm when it stretched.

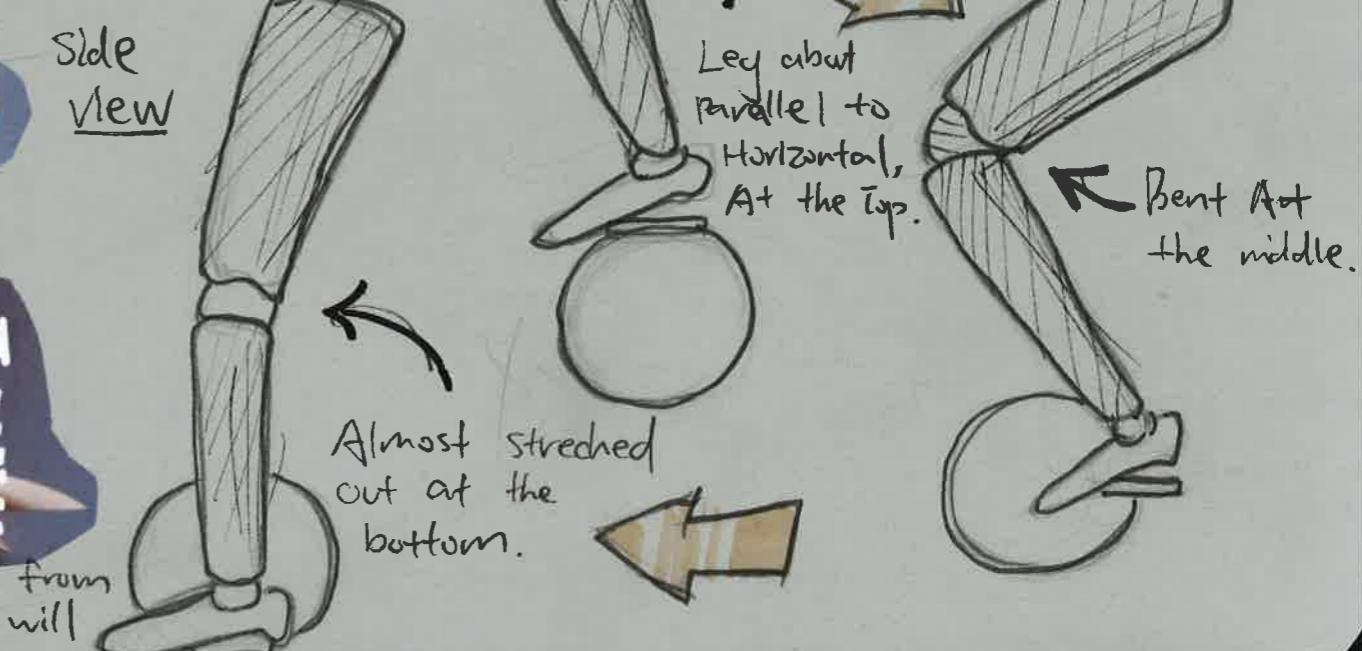
Adjust the size due to ergonomic purpose,
Refine the frame, front fork & crank set from previous.

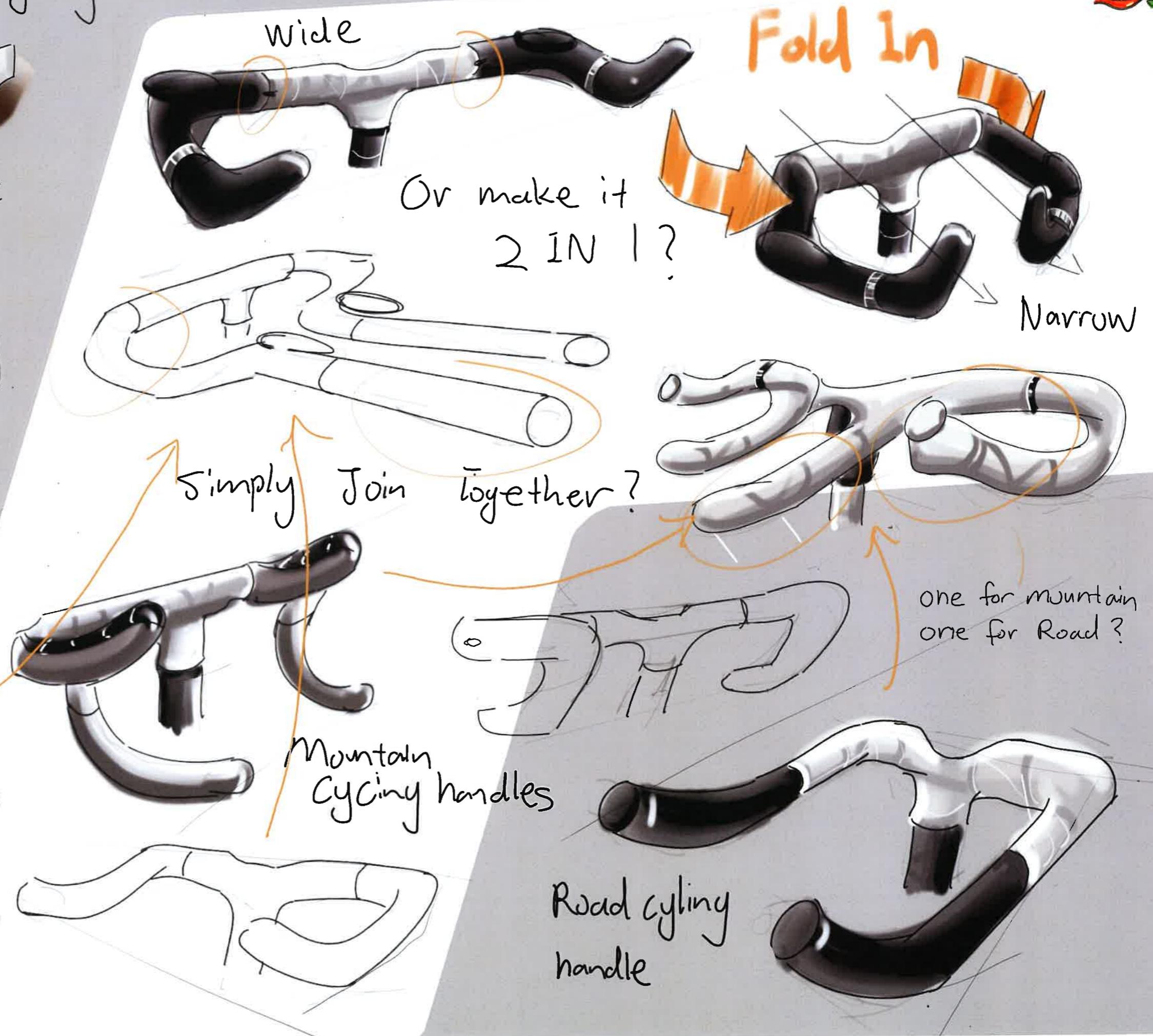
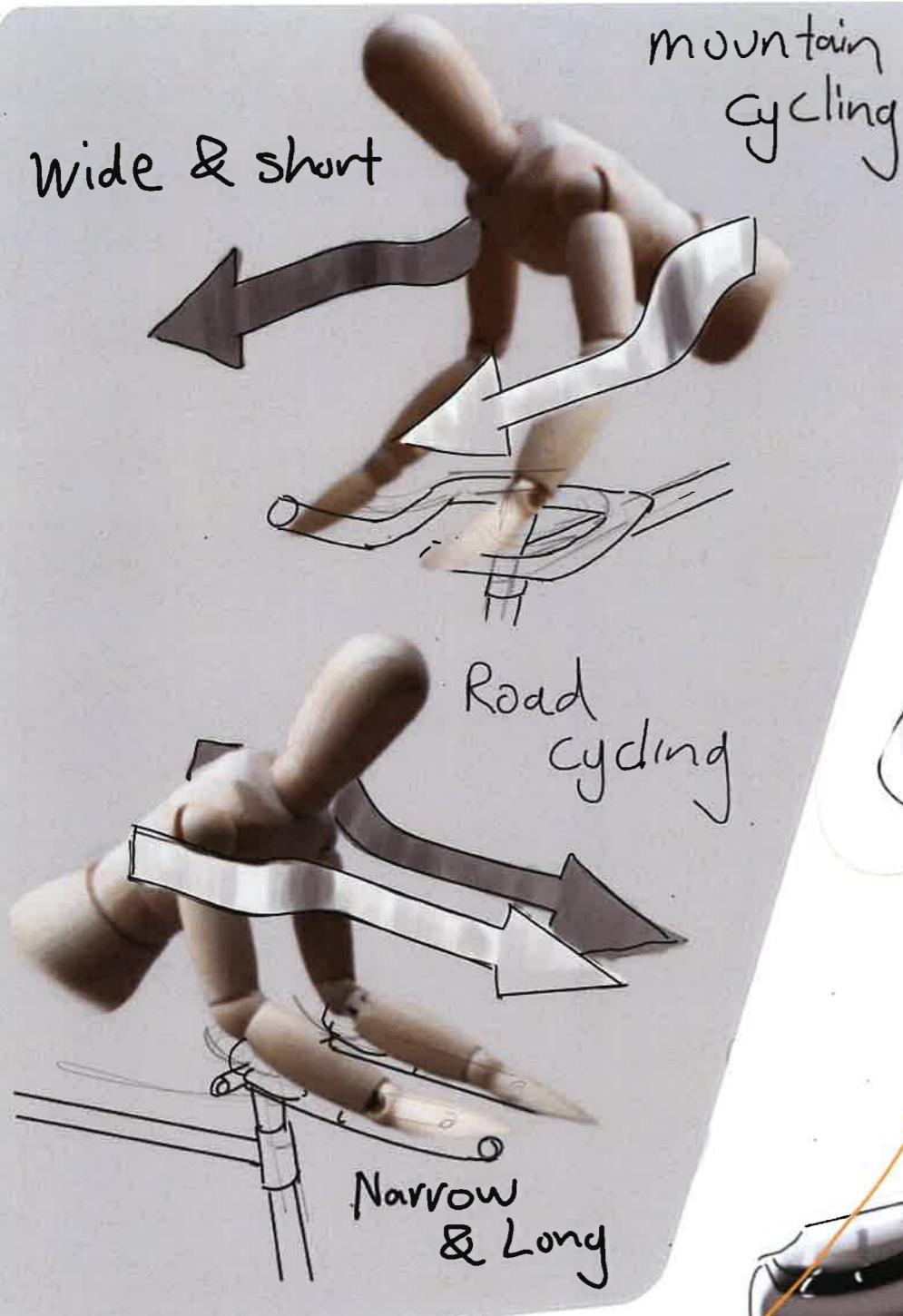


And 620mm when it bent.

Side view

Almost stretched out at the bottom.



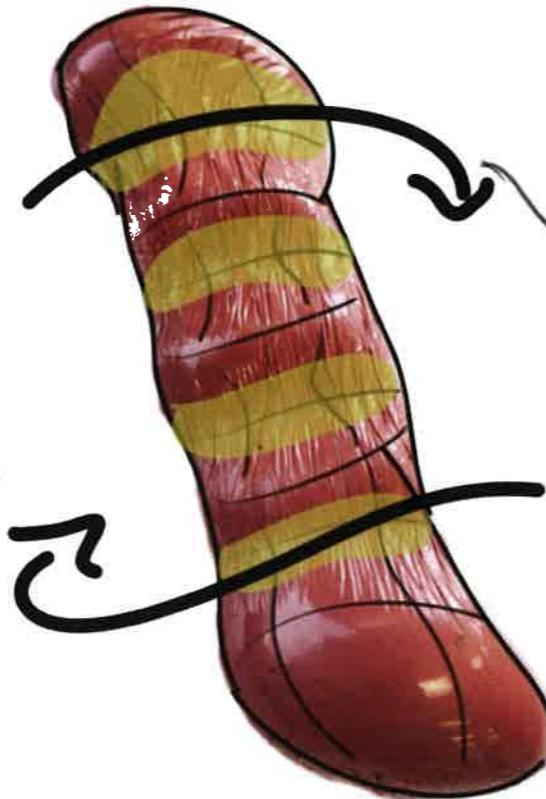




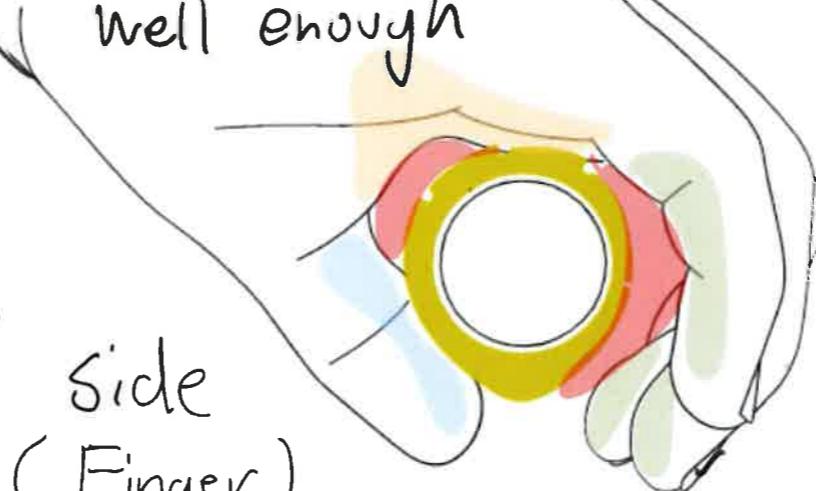
Easy
shape
to clay



Hold
Tight

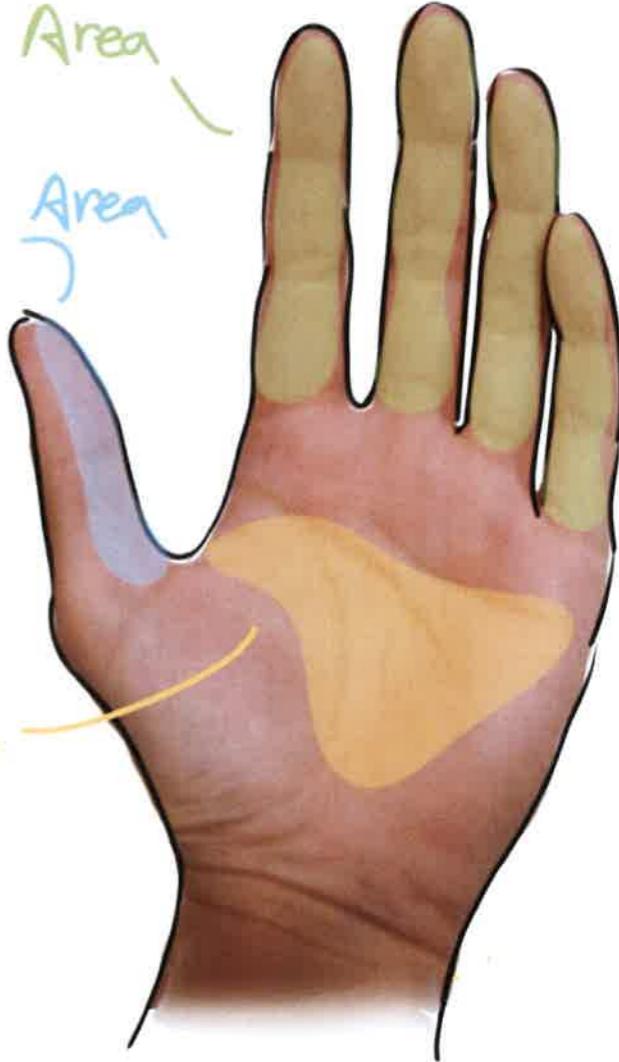


Normal handle grip
doesn't fit the hands
well enough

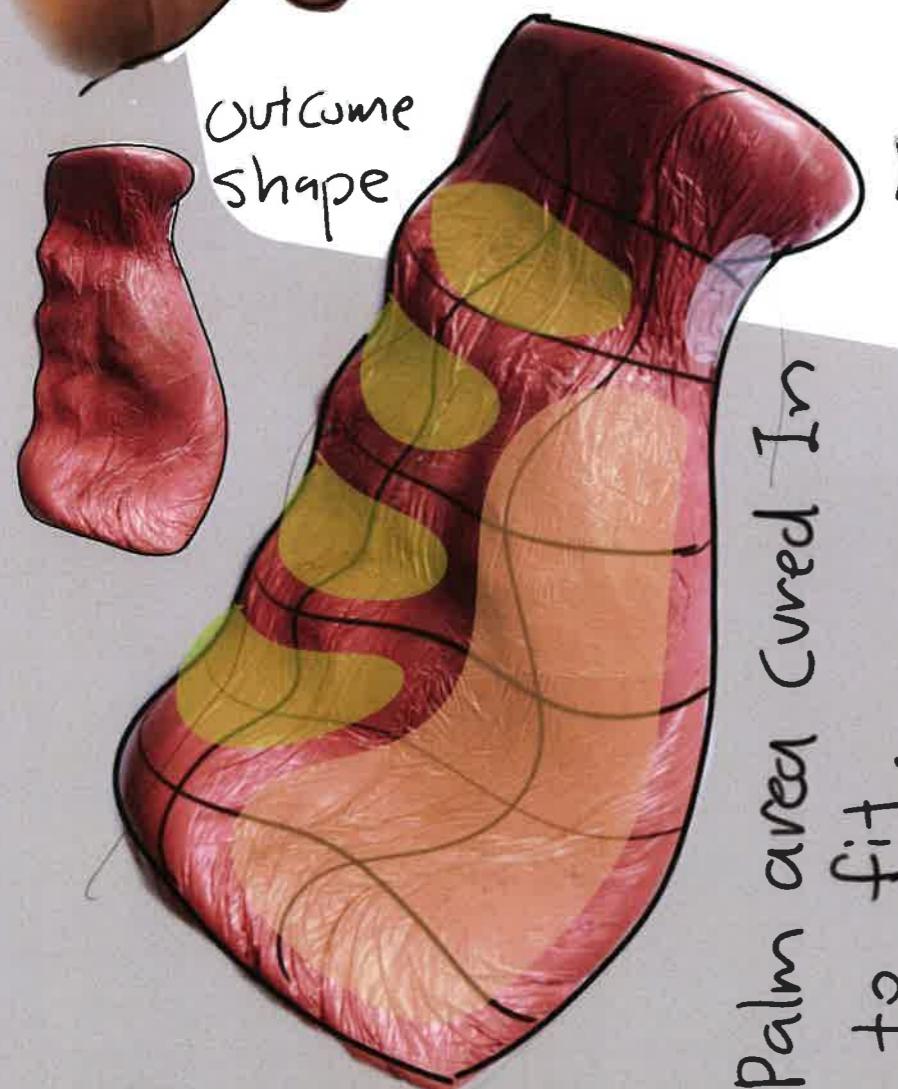


Side
(Finger)

Finger Area
Thumb Area



Ergonomic
of
handle grip

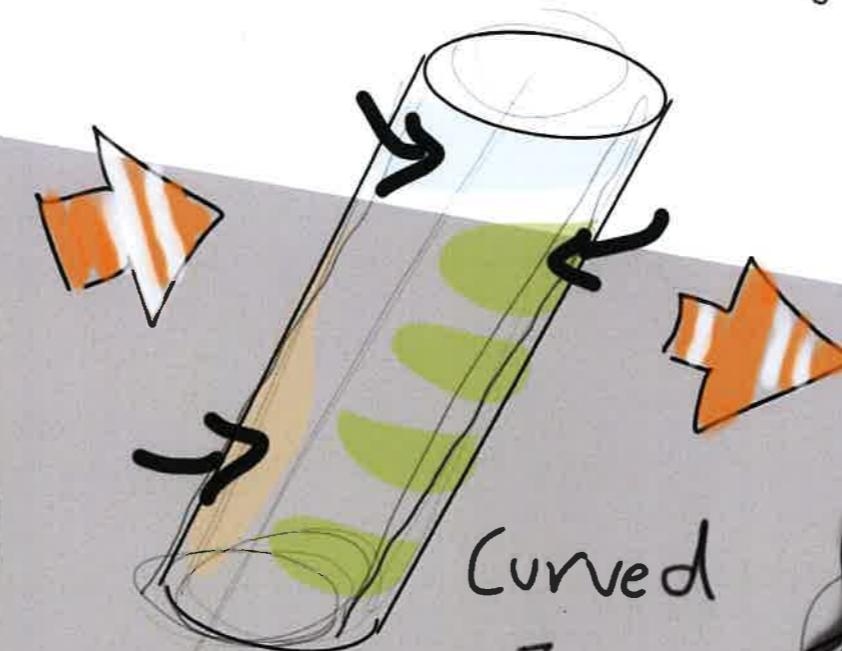


Front (palm)

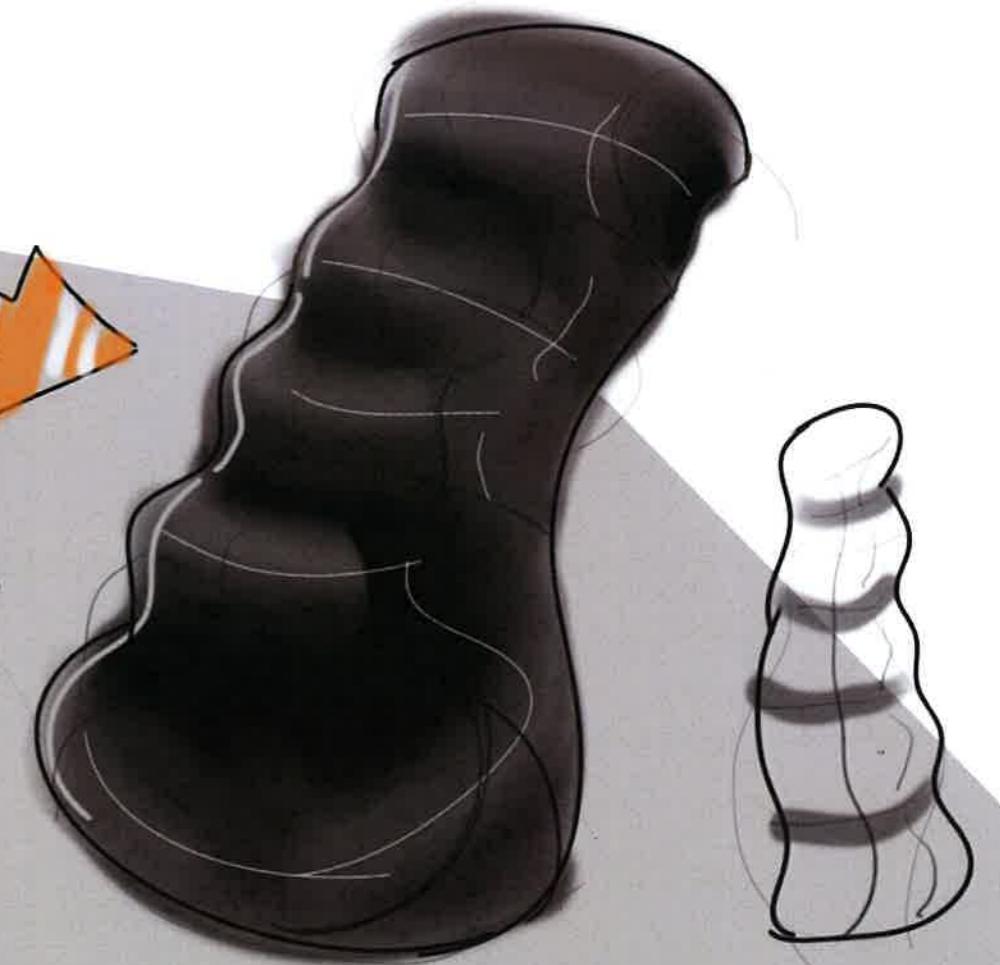
Palm area cured In
to fit.



Back (Finger tips)



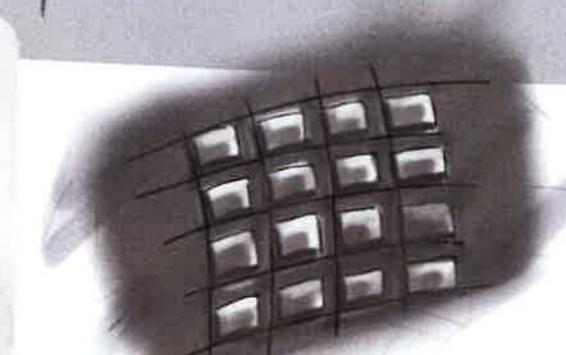
Curved
In



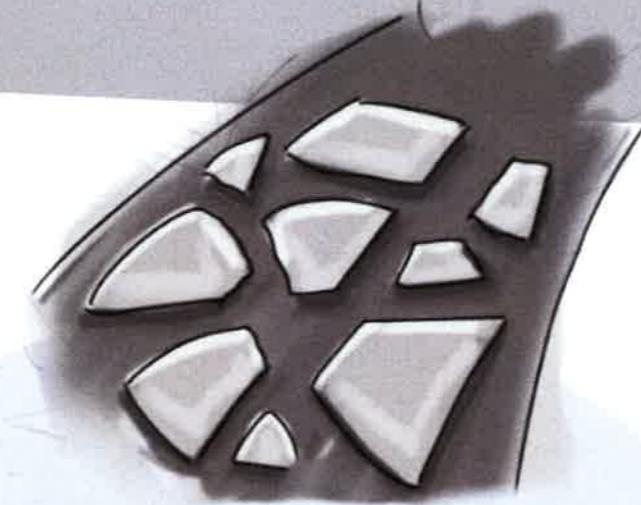
REFINING: REFINING THE TEXTURE ON HANDLE BAR



Grip pattern



dot pattern

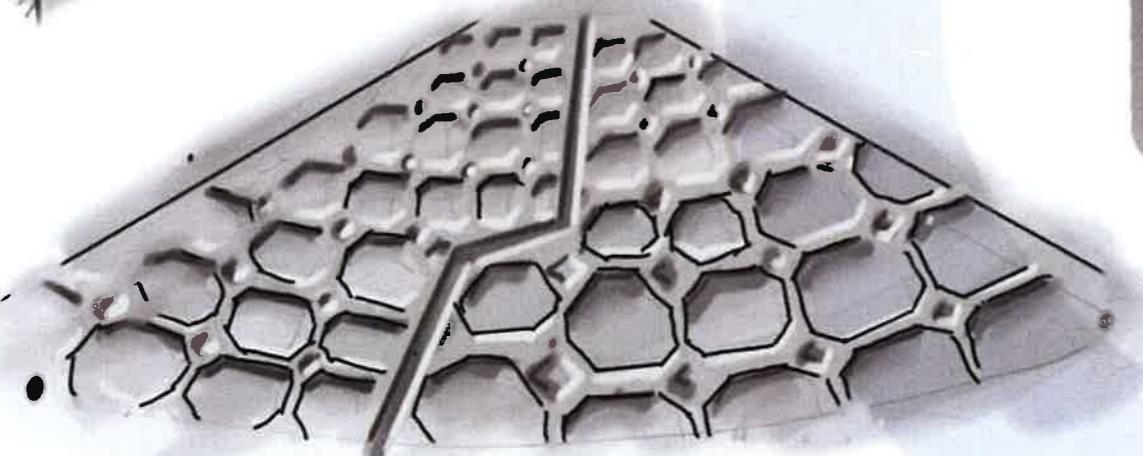


Irregular pattern



Finger area should have more Friction, therefore using Grid pattern texture.

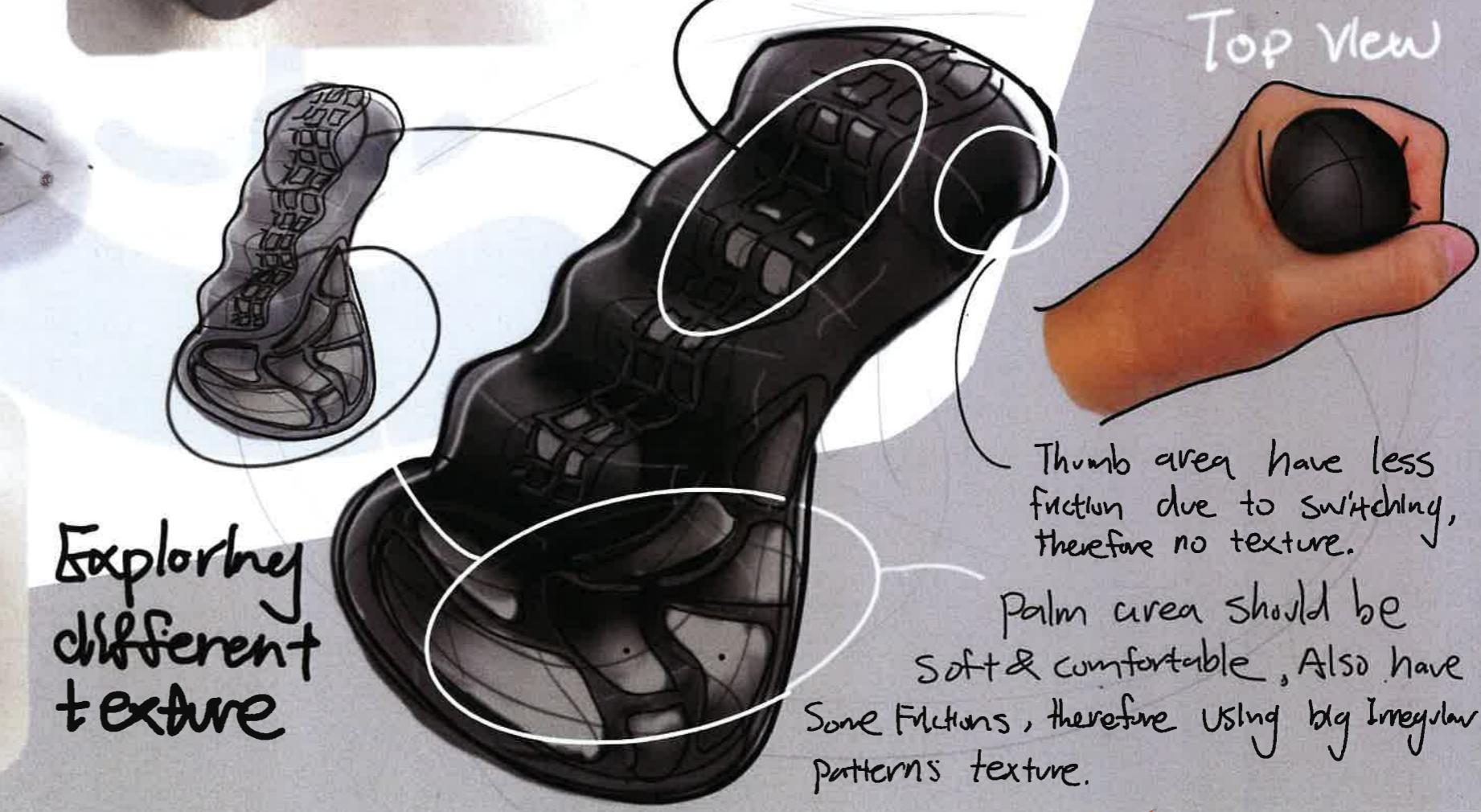
Top View



Beehive pattern



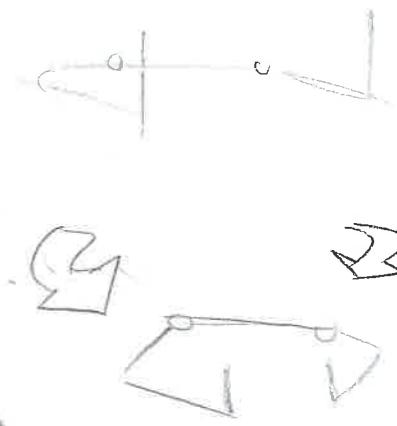
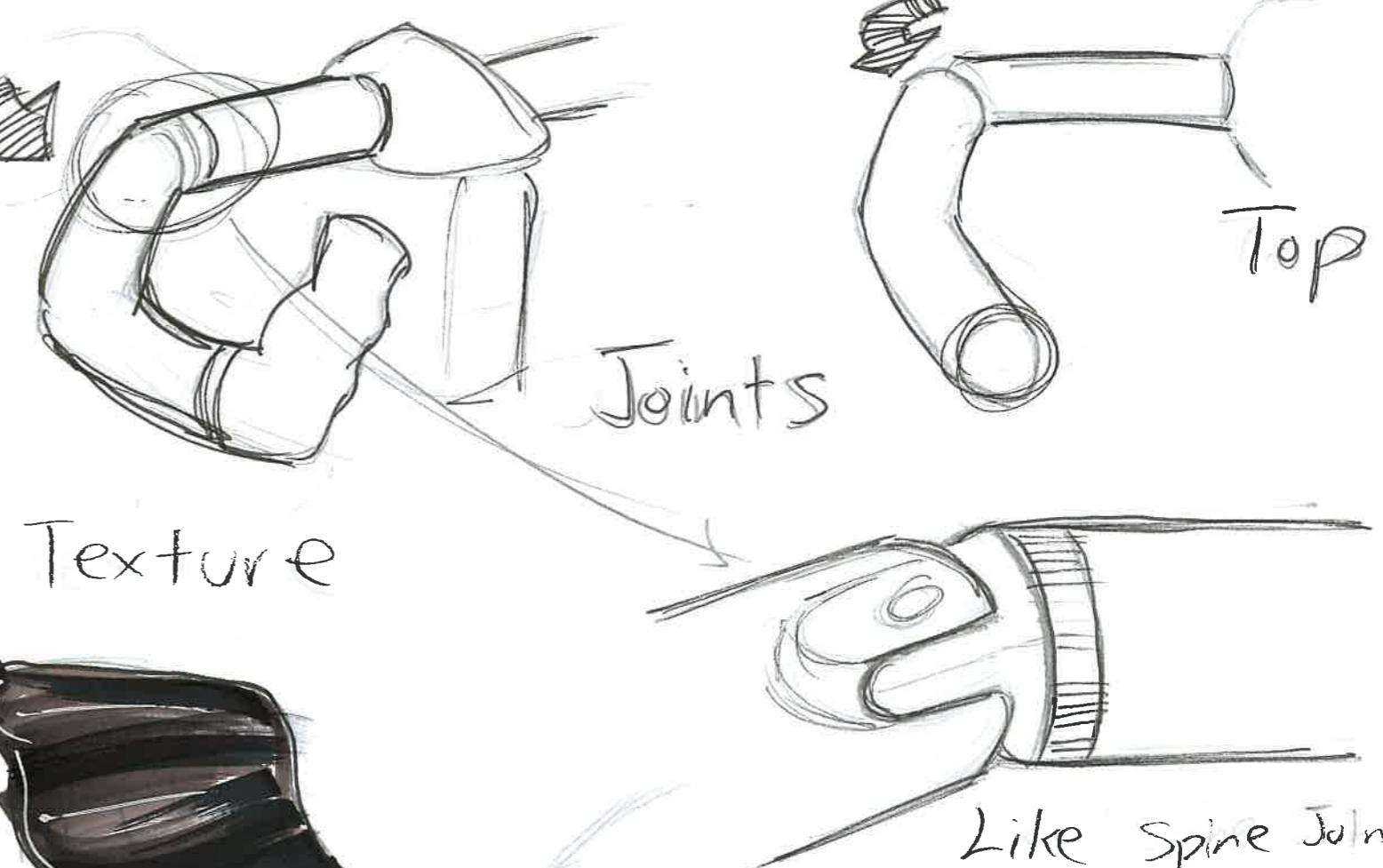
Exploring different texture



FINALISE HANDLE



Comfort



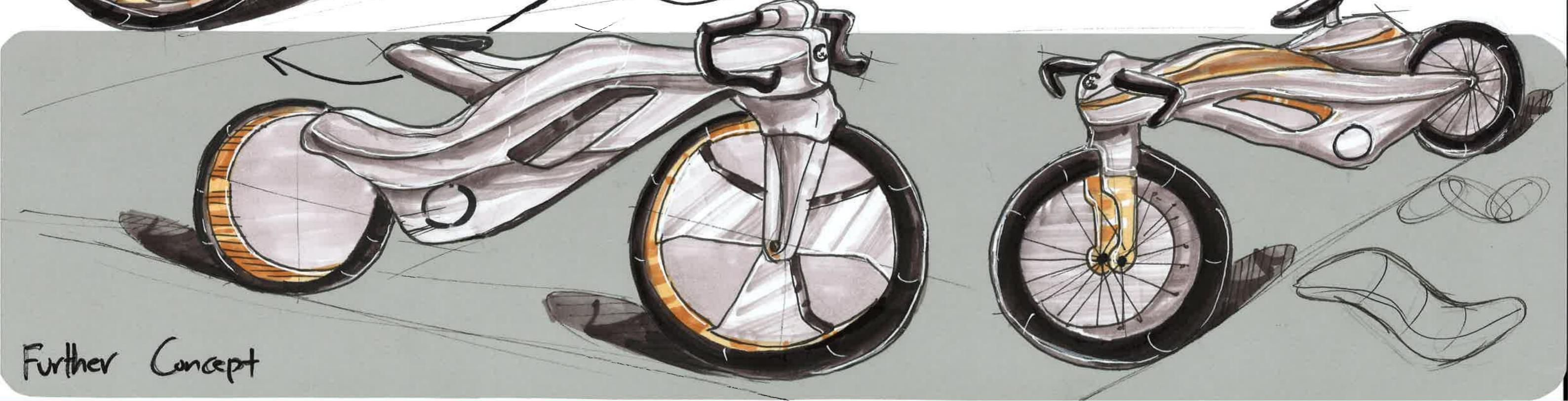
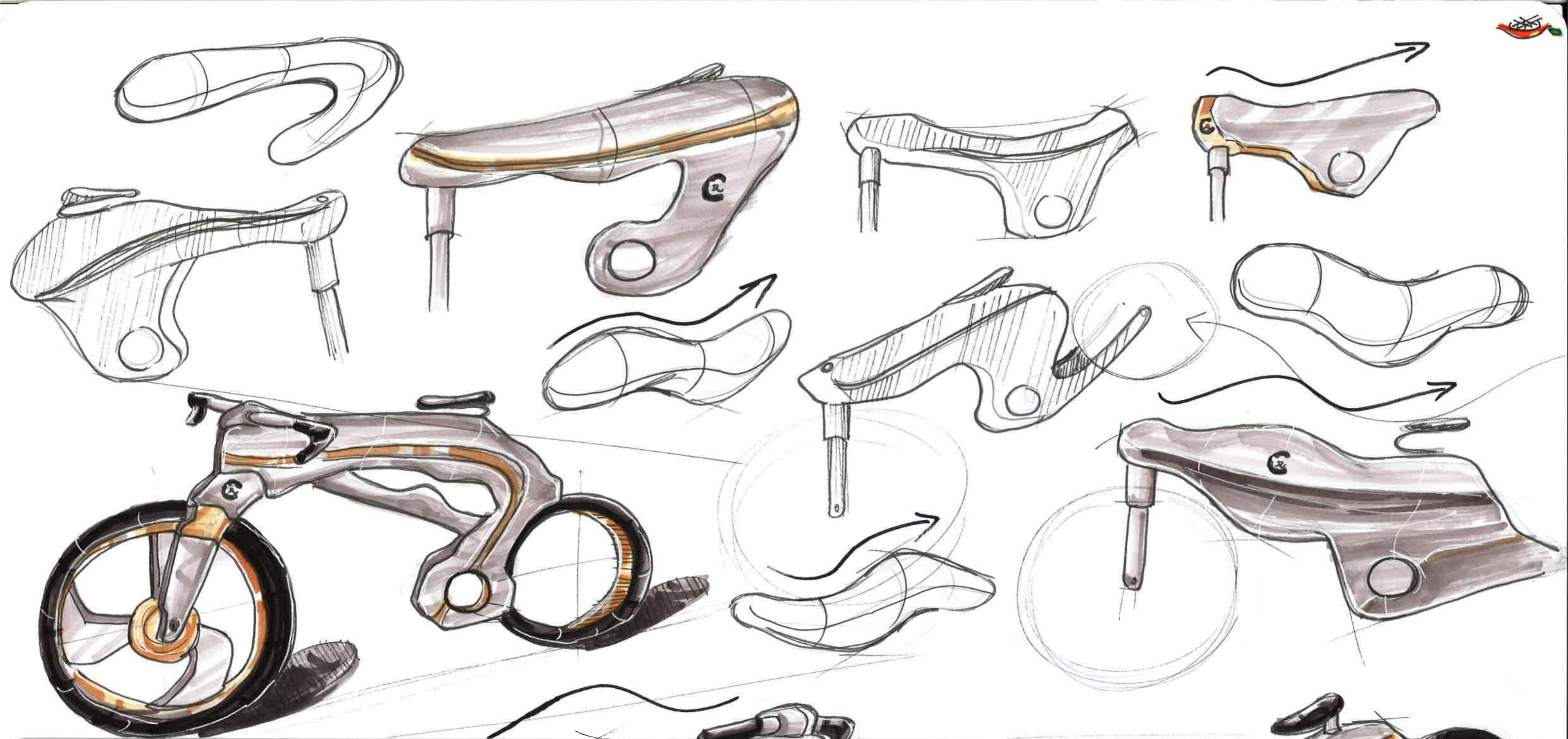
Suspension system countervail
the shock and bumps.

Leopard have excellent
leaping ability

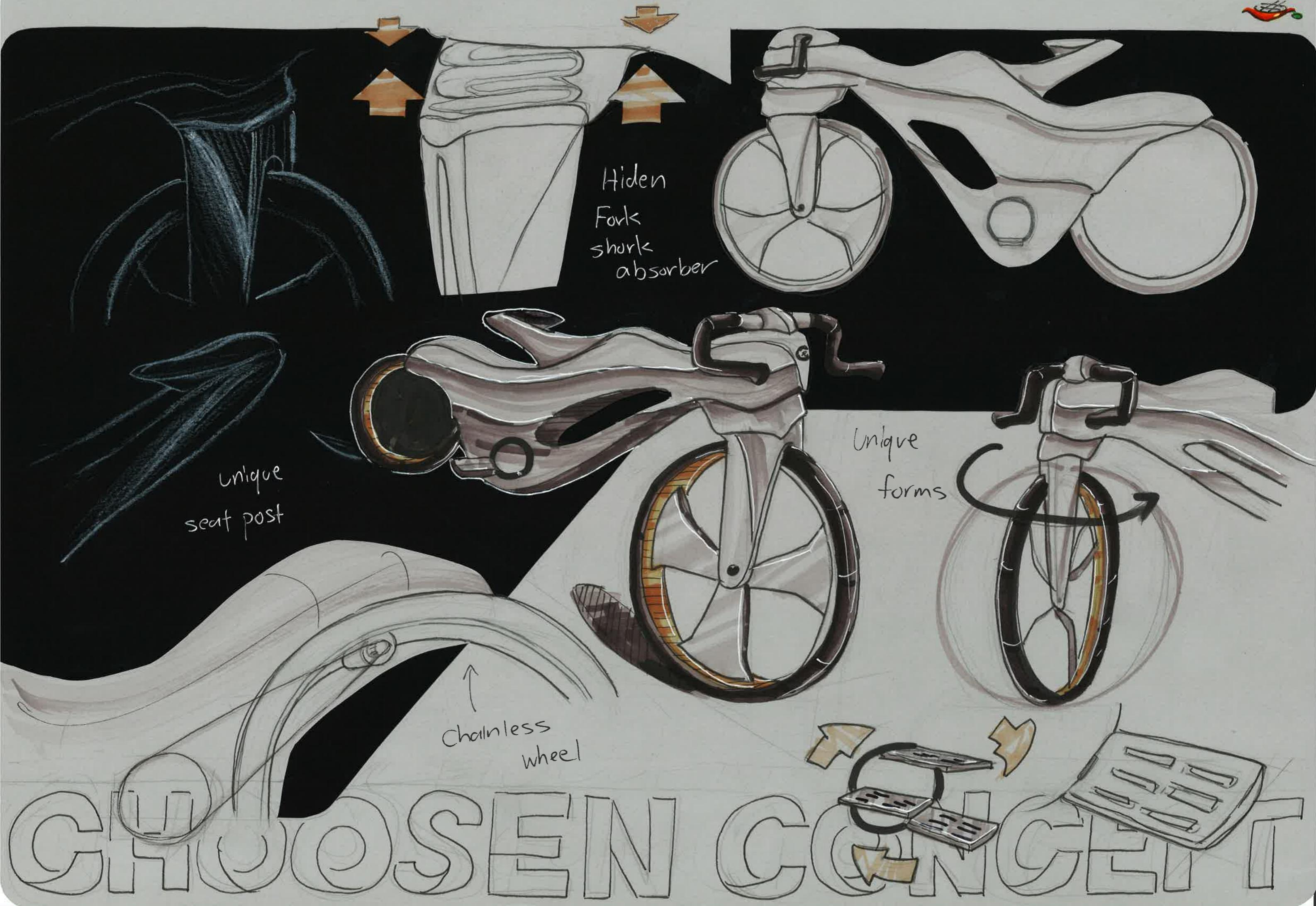
Leopard's leg can
bend, compress like
spring to reduce impulse

Full suspensions is very
important to Mountain bike

BICYCLE SUSPENSION SYSTEM

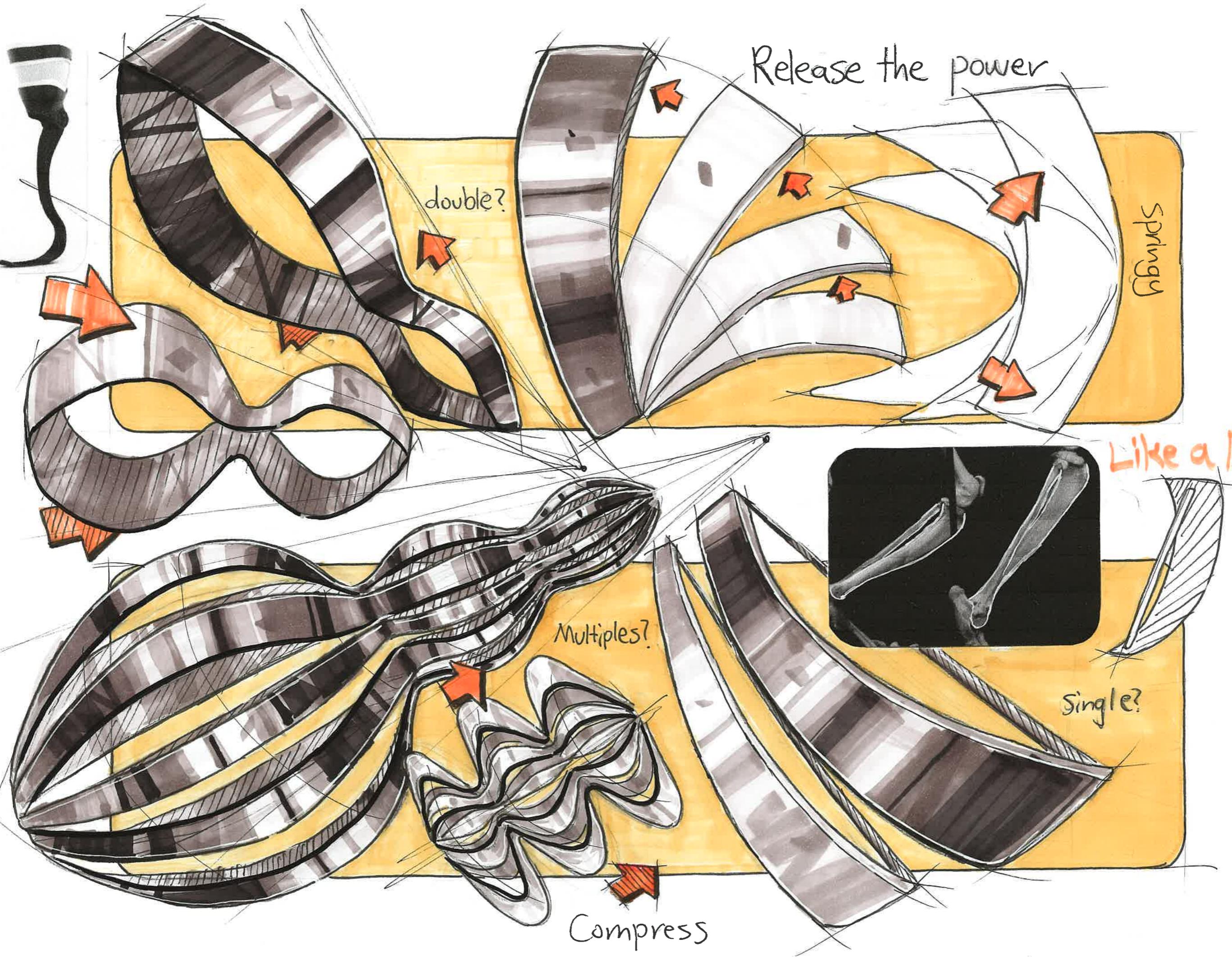


Further Concept



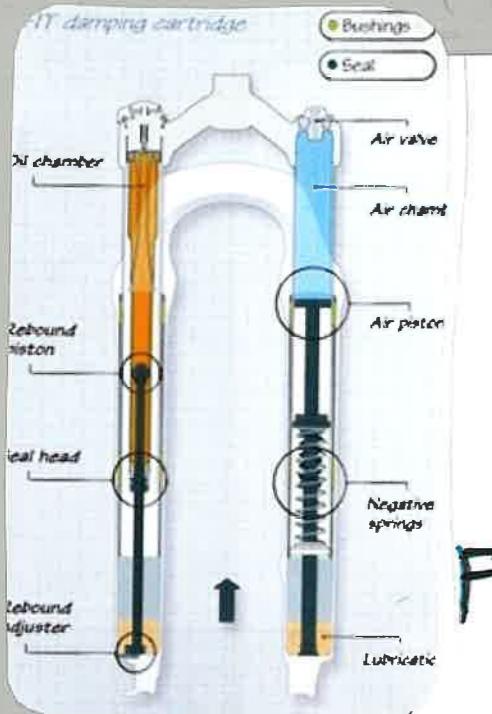


Like a prosthetic leg?

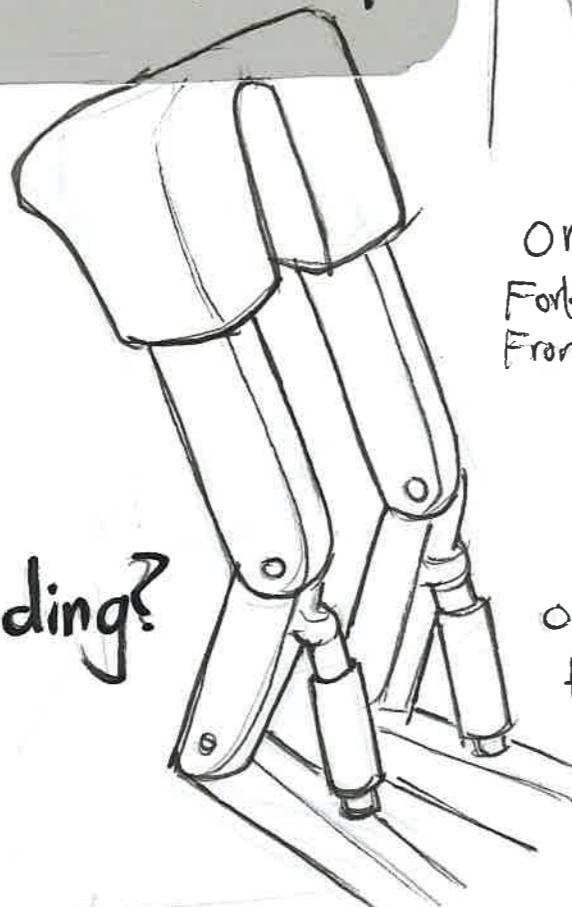


DEVELOPMENT

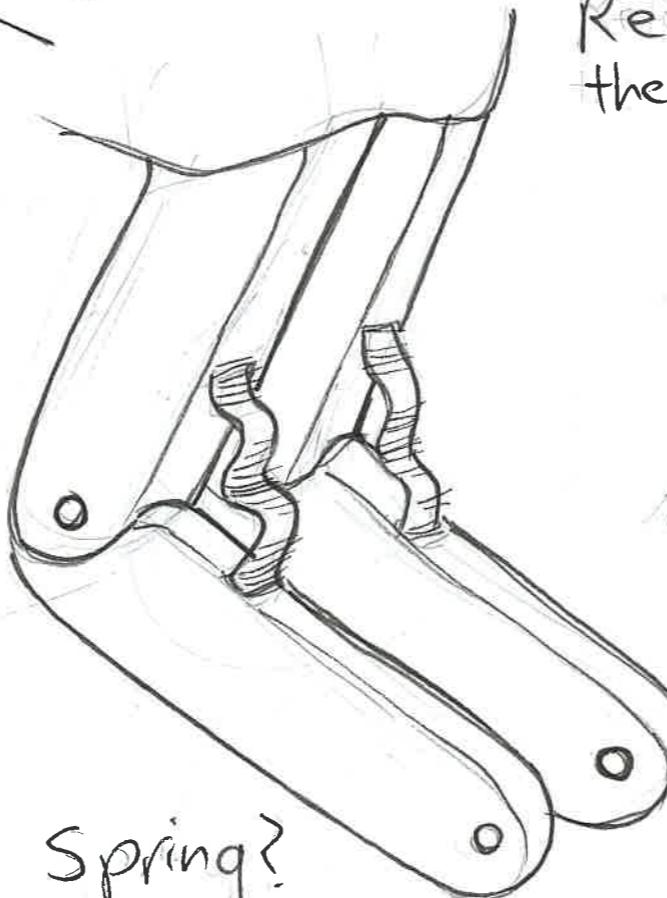
Fork Suspension



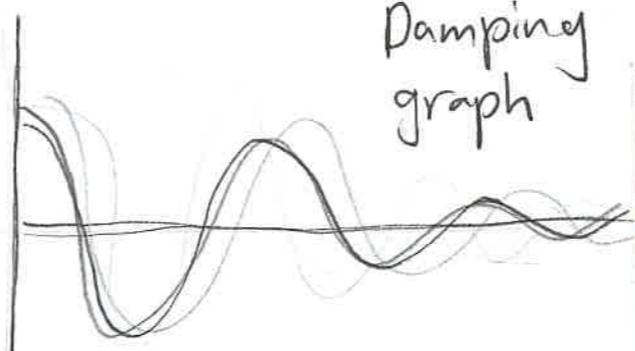
Folding?



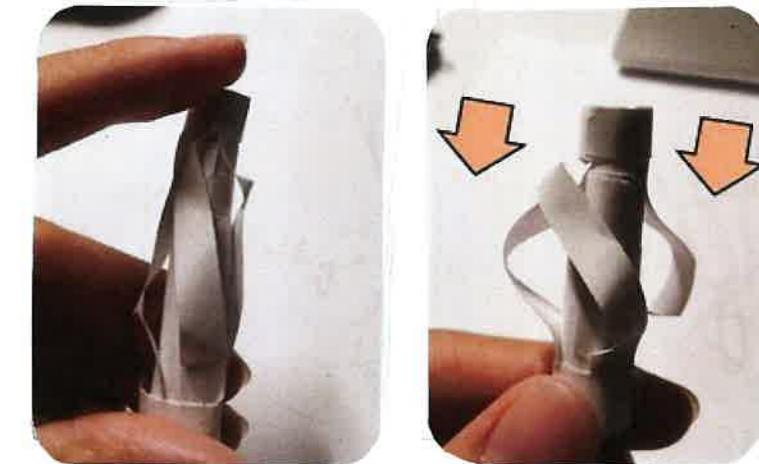
on the fork?



Only Spring?
using high flexibility steel

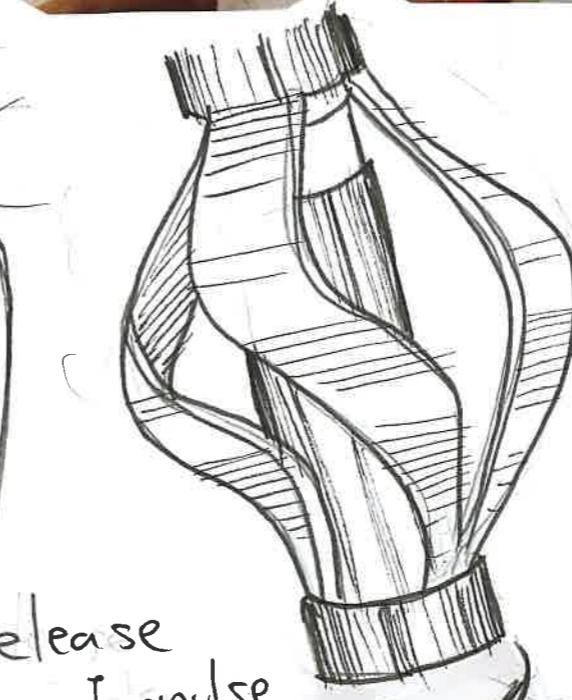


Spring to storage the Impulse
Air tube to resist the repuse

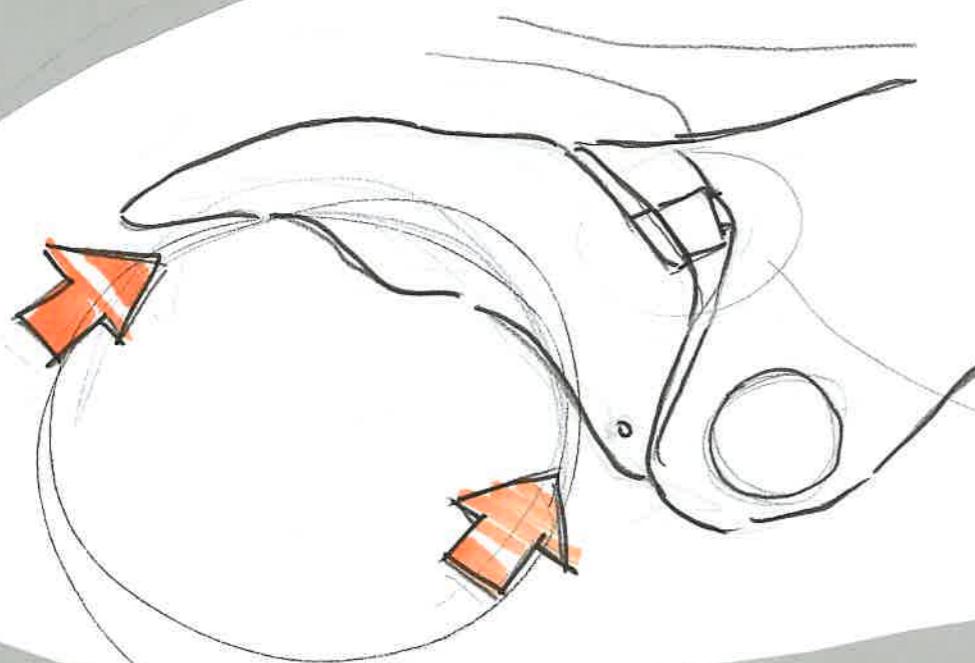


Spring suspension

In a Arc?



Negative tube of Air
Positive tube of spring

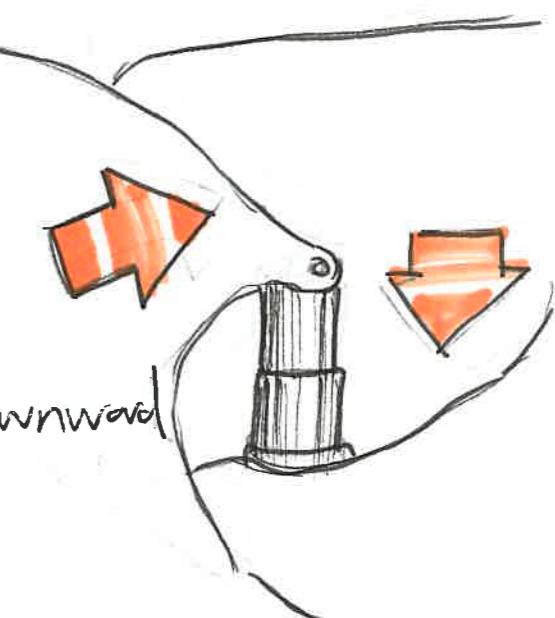


Normal Suspension

Install
a Large
shock absorber
on bike Frame?

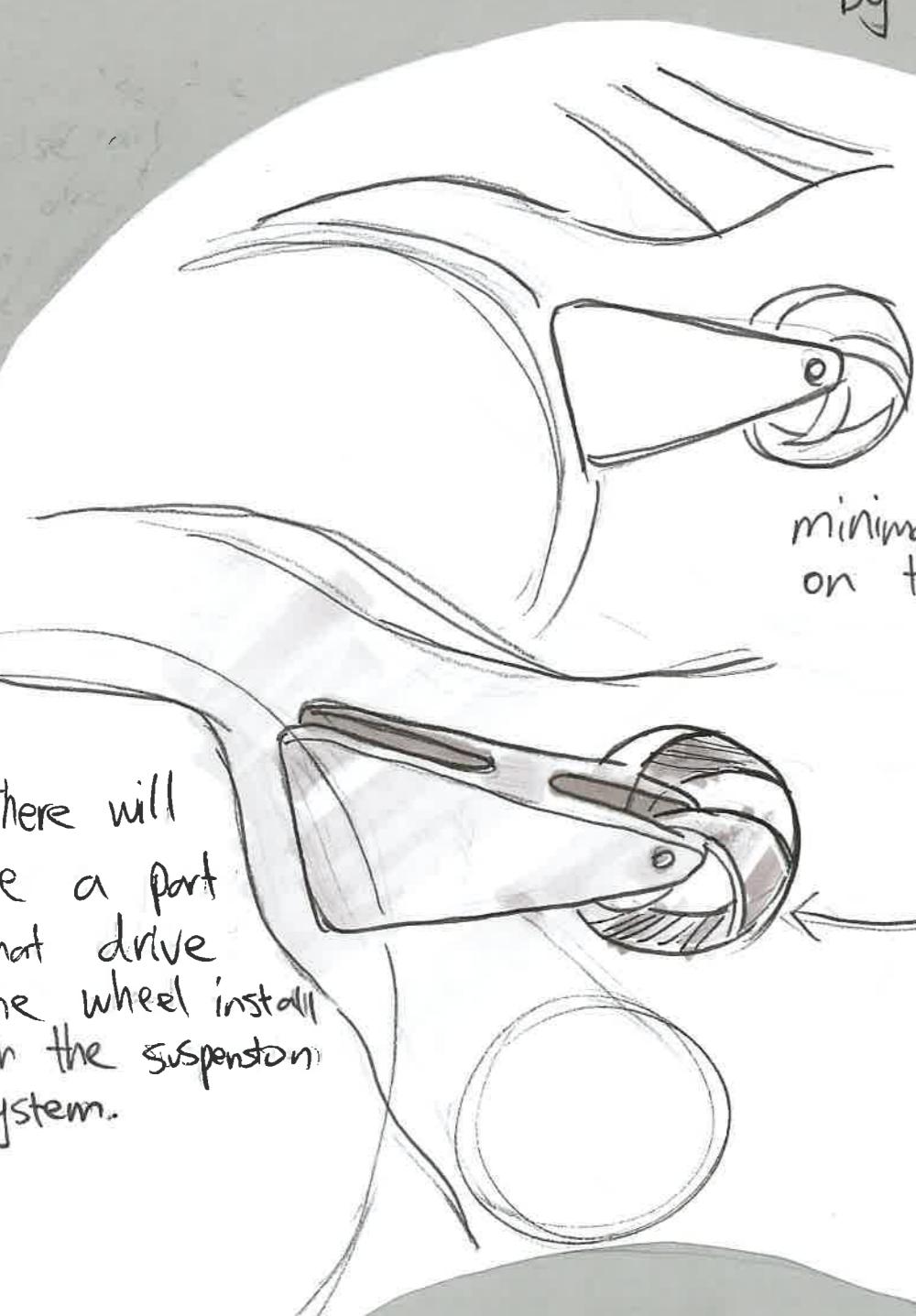
or
Further
upgrade?

This is only suspension
in single axis

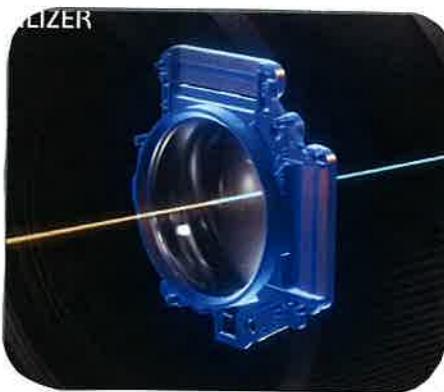
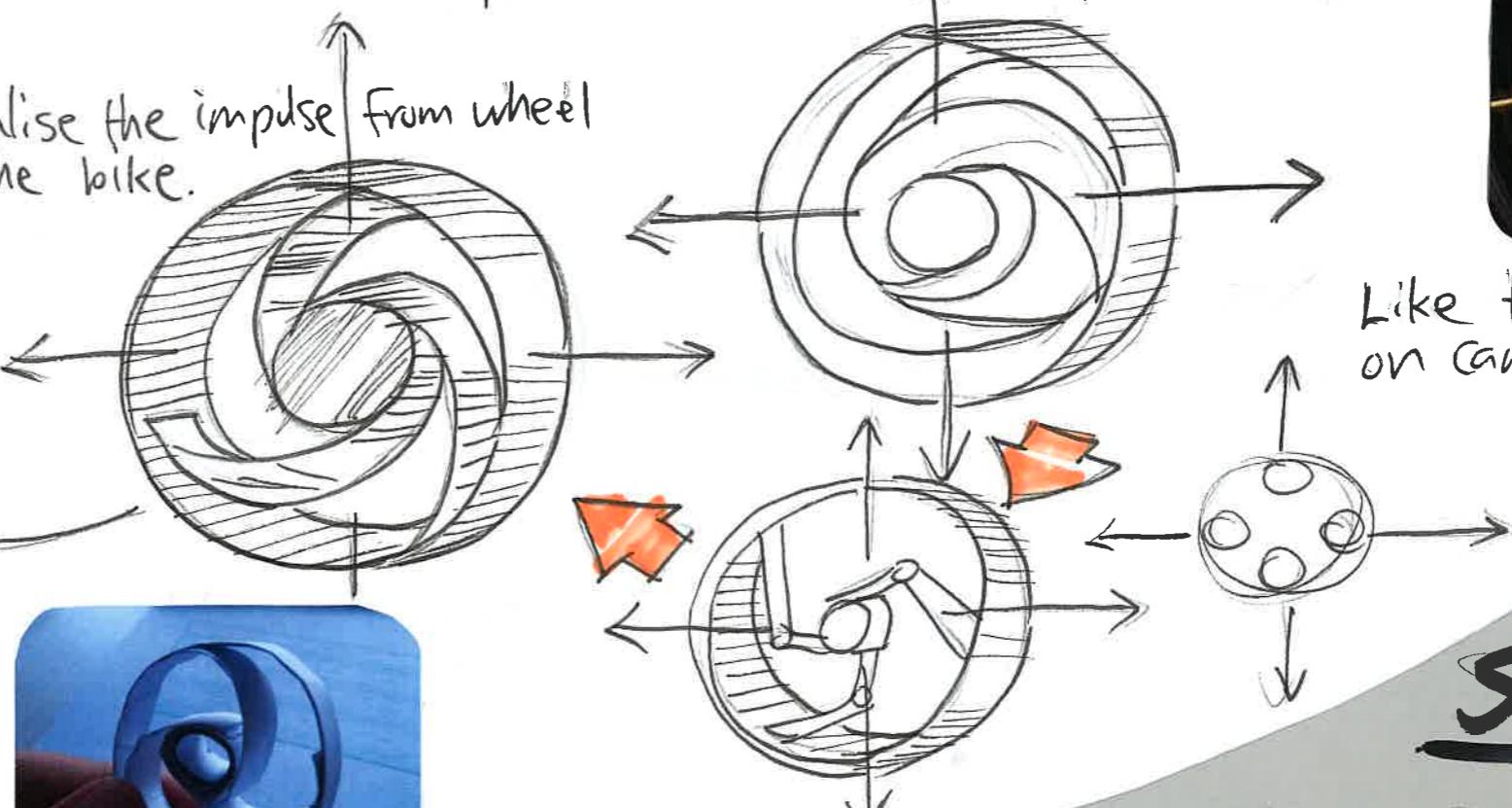


Push Downward

By installing the Stabilisation system
in the bike, Completely separate
the wheel & the Frame
of the bike.

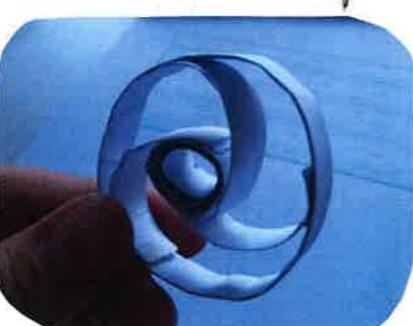


Four Axis Suspension?

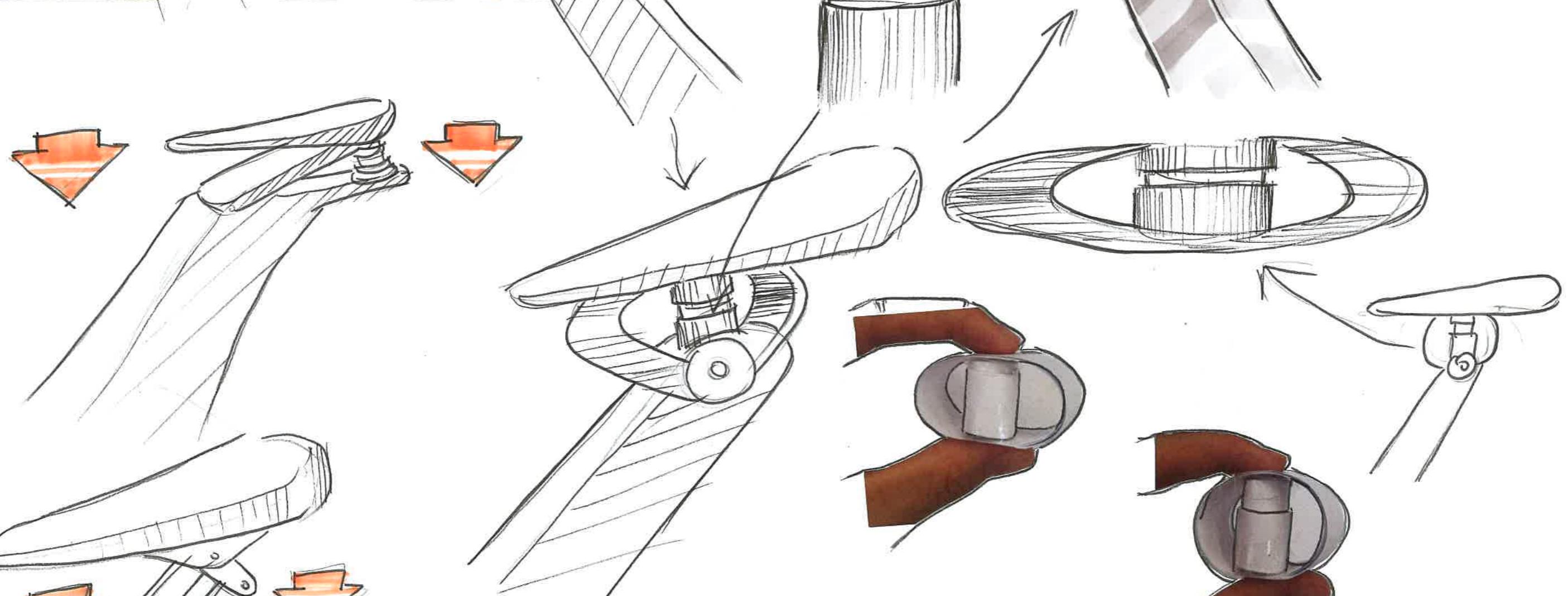
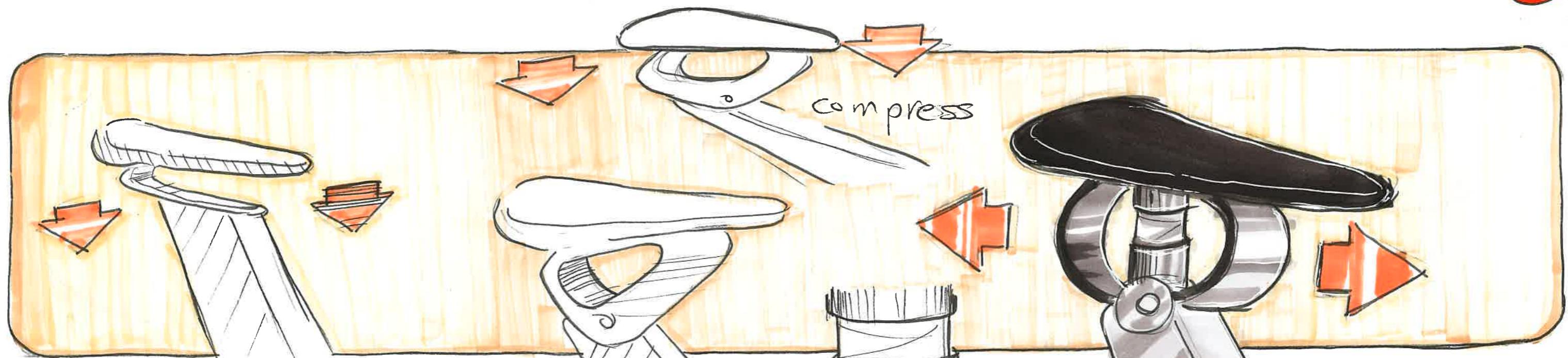


Like the Stabilization
on camera?

There will
be a part
that drive
the wheel install
on the suspension
system.



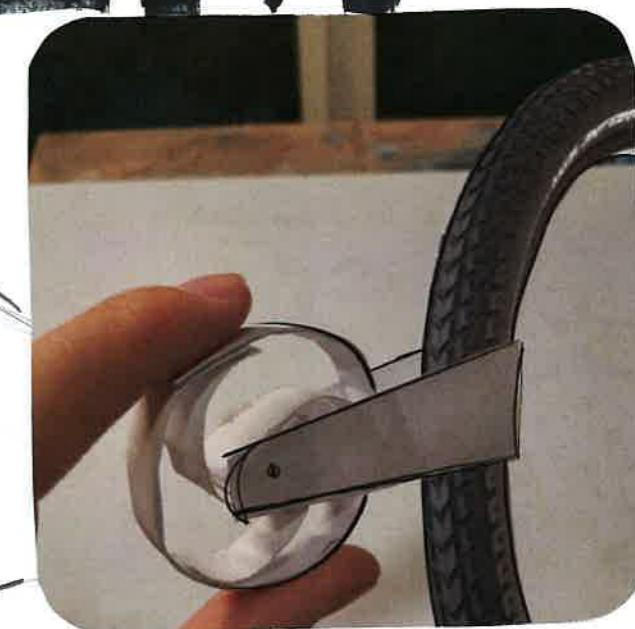
**Rear
Suspension
DEVELOPMENT**



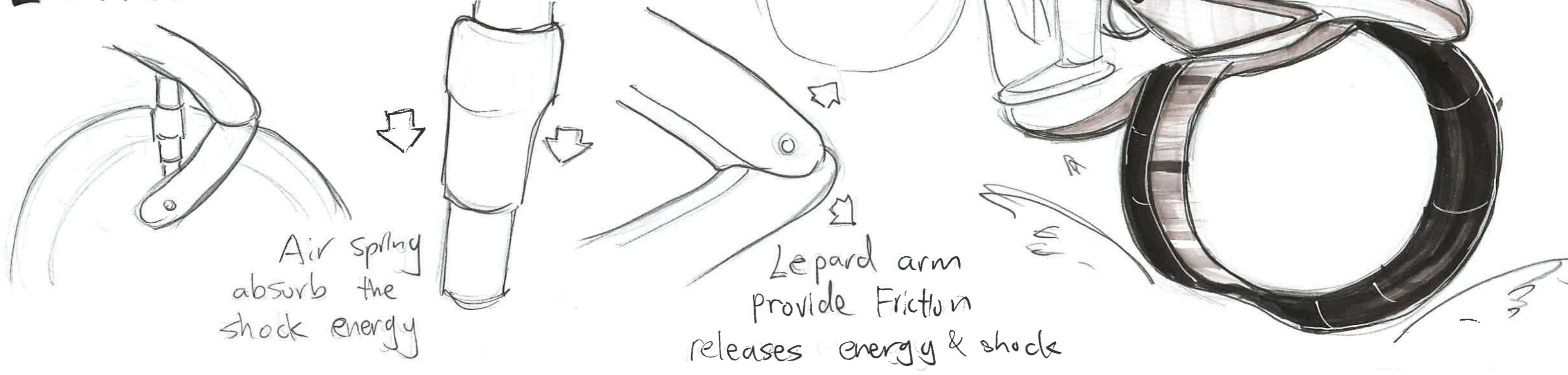
SEAT SUSPENSION

SUSPENSION SYSTEM

Leopard Leg
& 4 Axis
Suspension

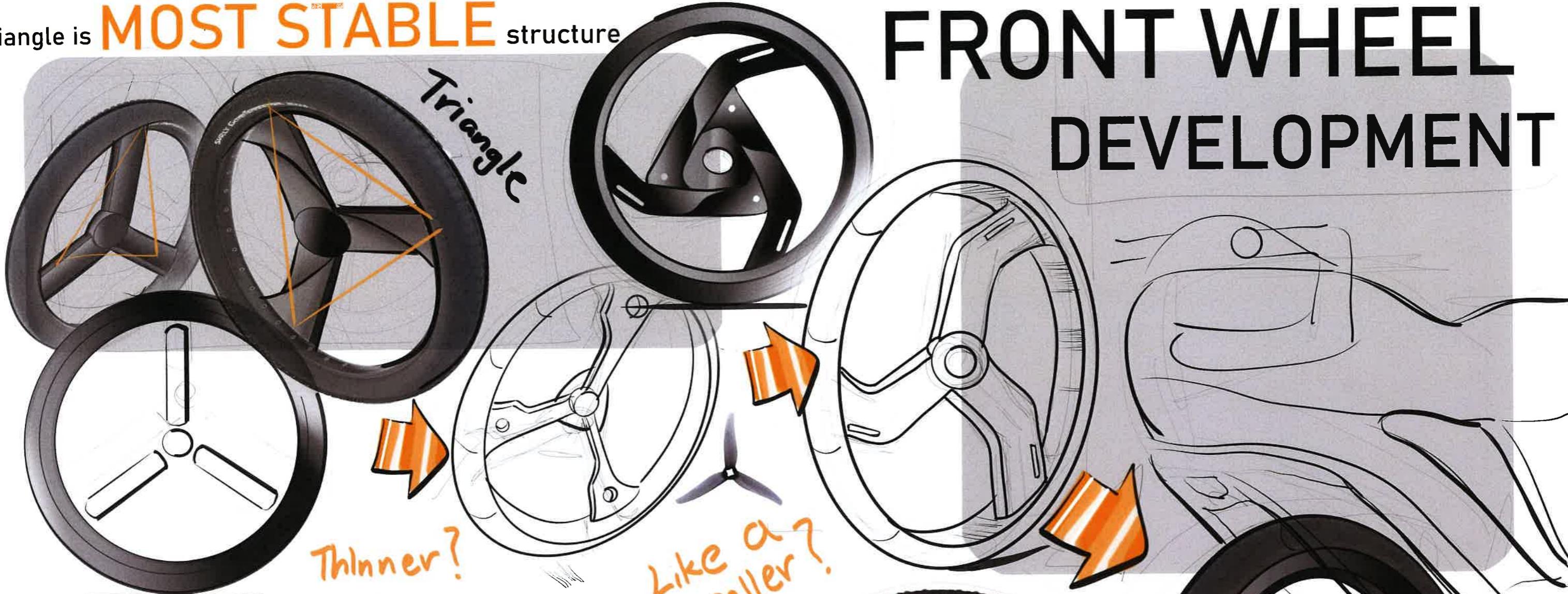


LAND LIKE LEOPARD

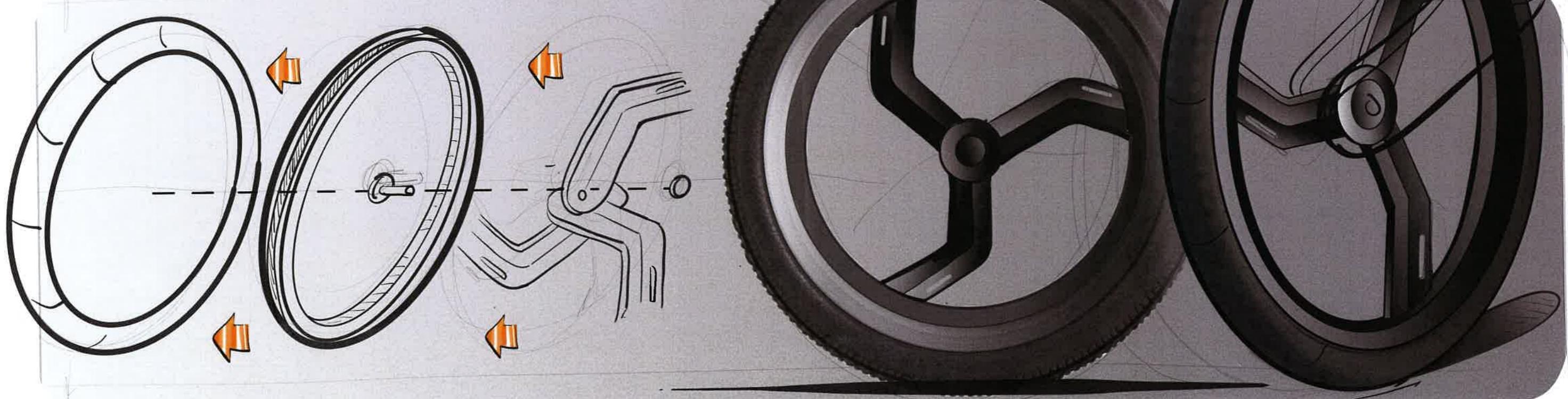


Triangle is **MOST STABLE** structure

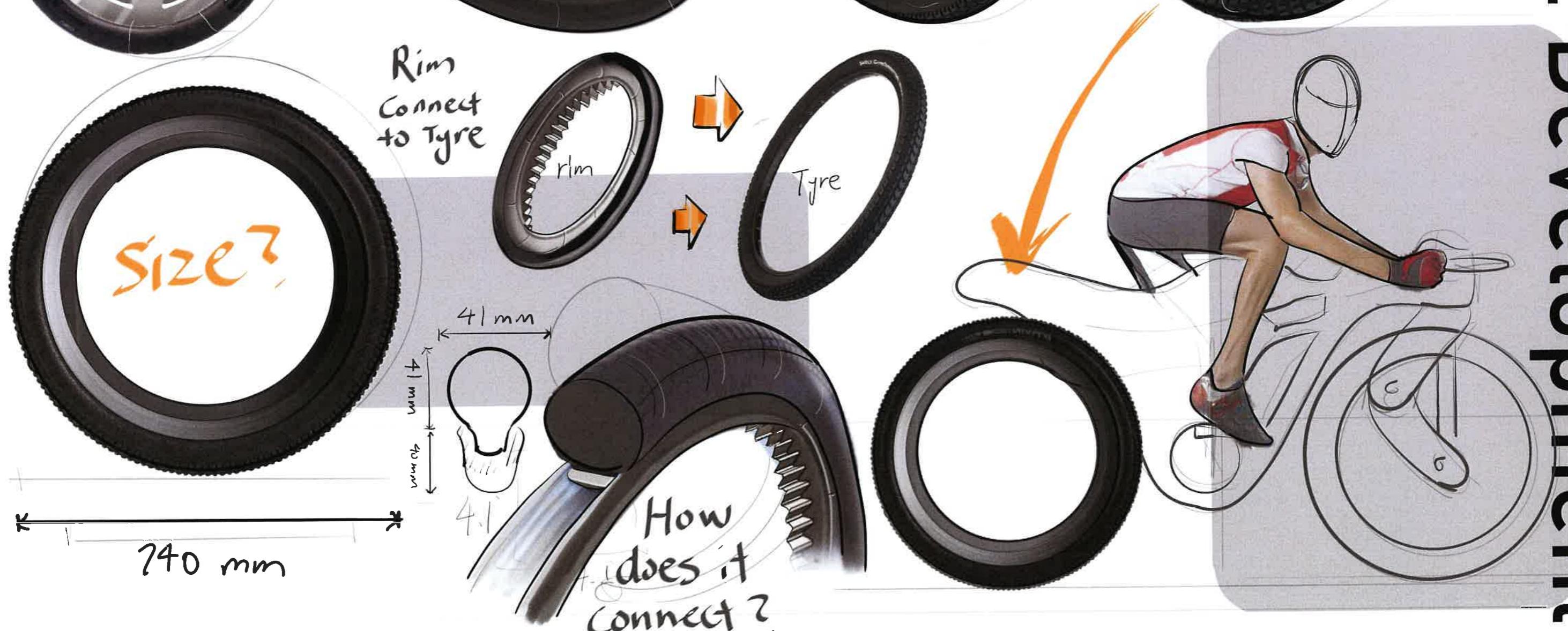
FRONT WHEEL DEVELOPMENT



Assemble of wheel



Rear Wheel Development



How Does The Rear Wheel Driving?

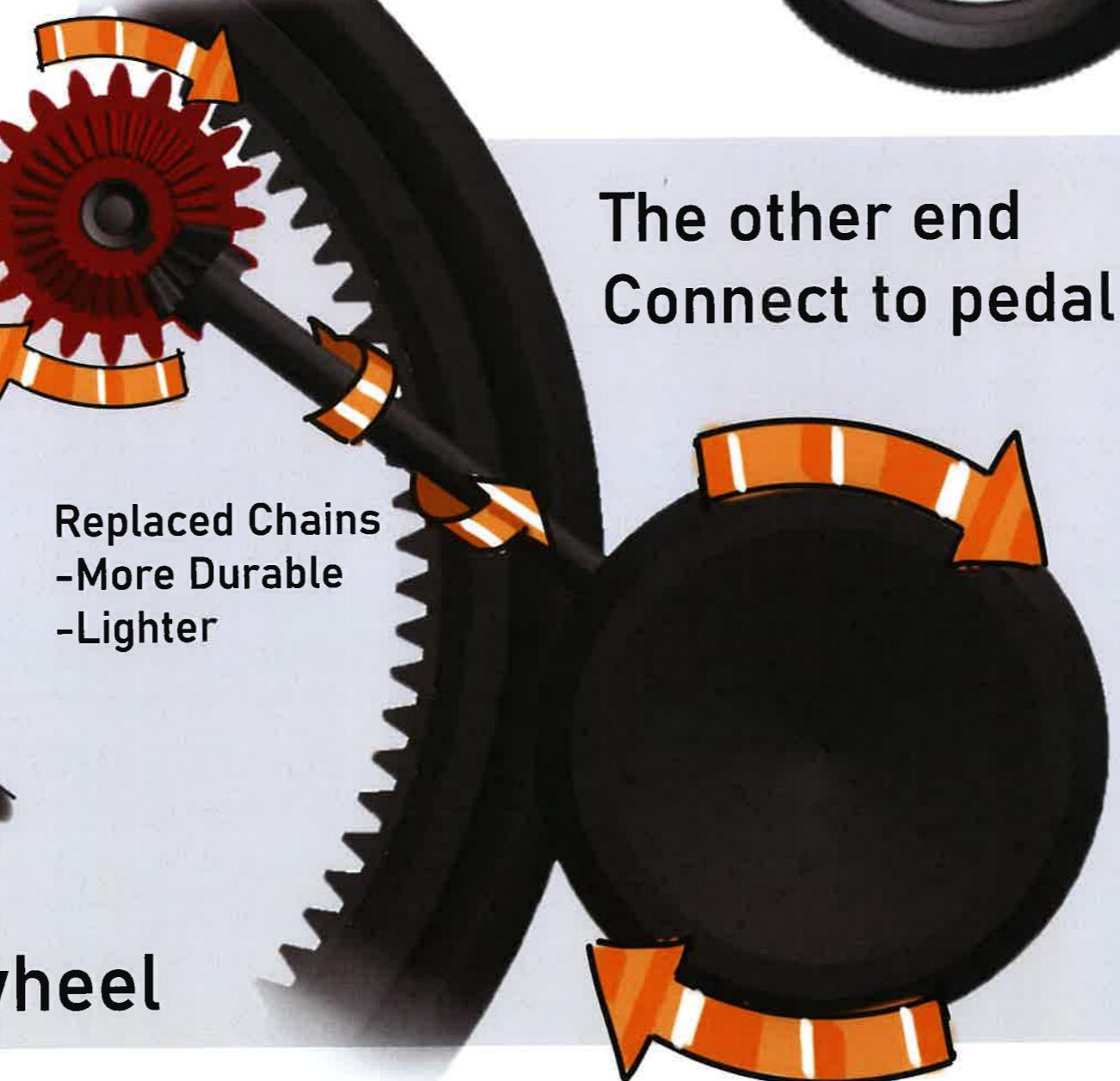
Chain-less
Driving system

Bearing and track
to fixed the wheel

Using bevel gears
and rotating rod



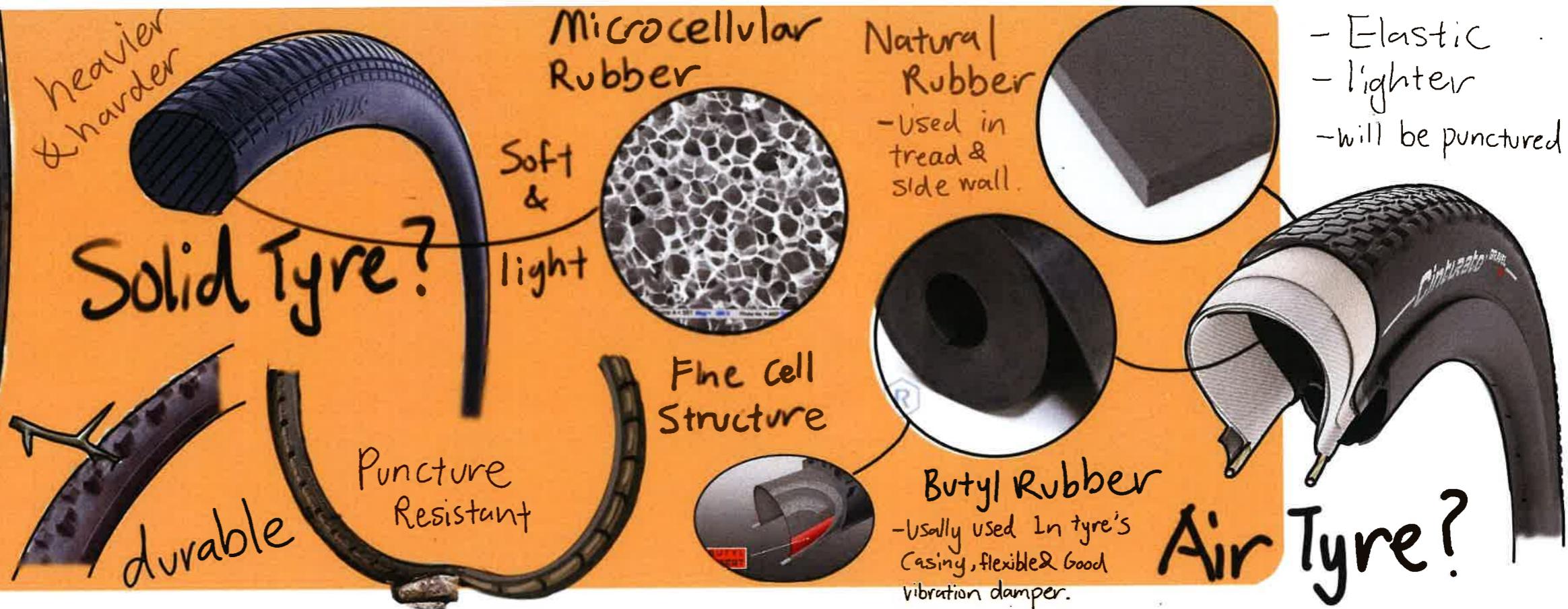
Two bevel gear connecting
Big internal gear on wheel



Bevel gear on pedal set

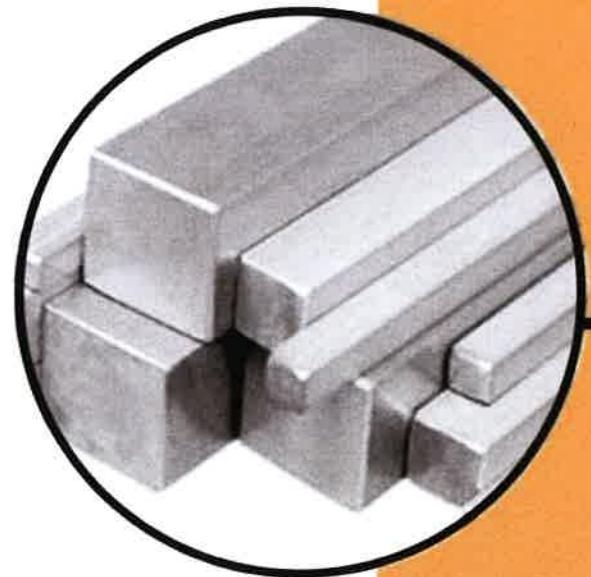
Tyre Material

I have chosen solid tyres for my bike. Solid tyres have a reputation for being slow, heavy, uncomfortable, but using microcellular rubber overcomes this issue. It has benefit of puncture resistance, which perfect for situation like mountain cycling.

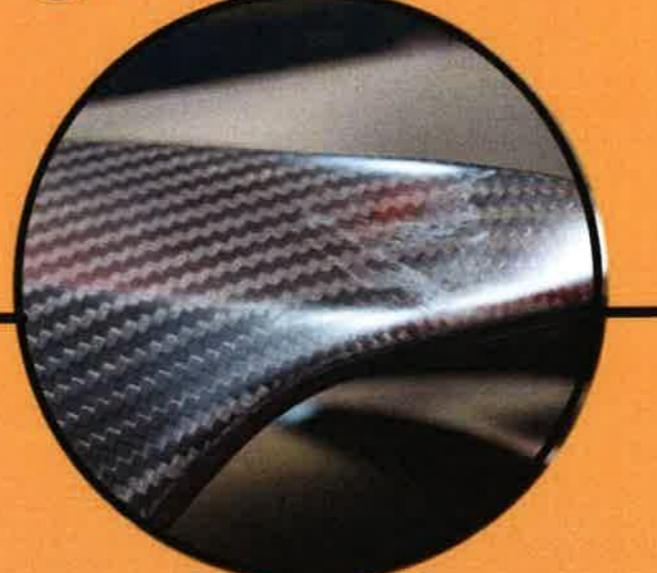


MATERIAL DECISION

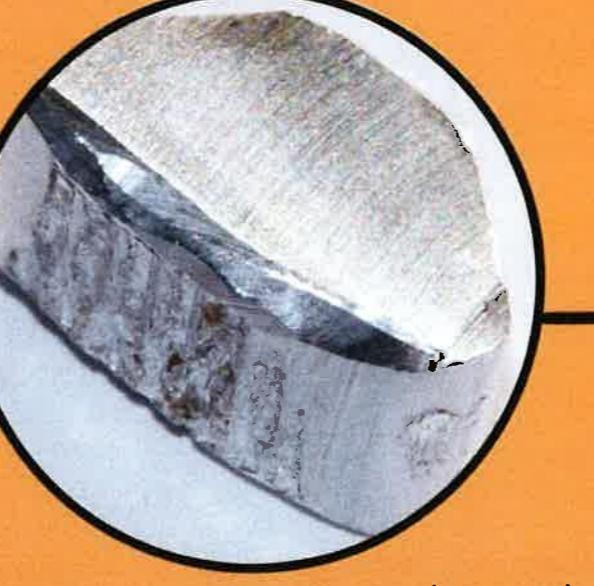
Steel



Carbon Fiber



Aluminium



RIM Material

I have chosen Carbon fibres as the material for my bike rim, but carbon fibres tends to perform poorly in wet and long descent situation, which normally see in mountain cycling. To solve this problem, I decide to use an existing approach of carbon fibre bike rim which a surface of aluminium.



- greater flexibility

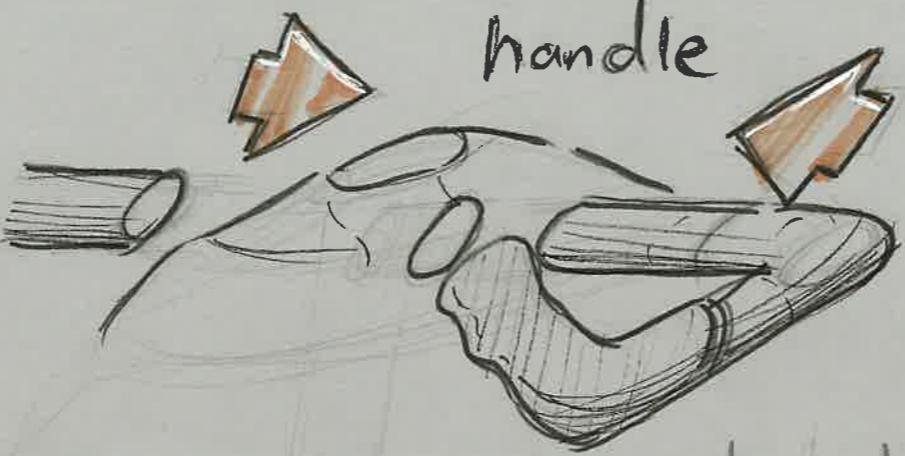
- high stiffness, Light

- lighter, $\frac{1}{3}$ of steel's weight

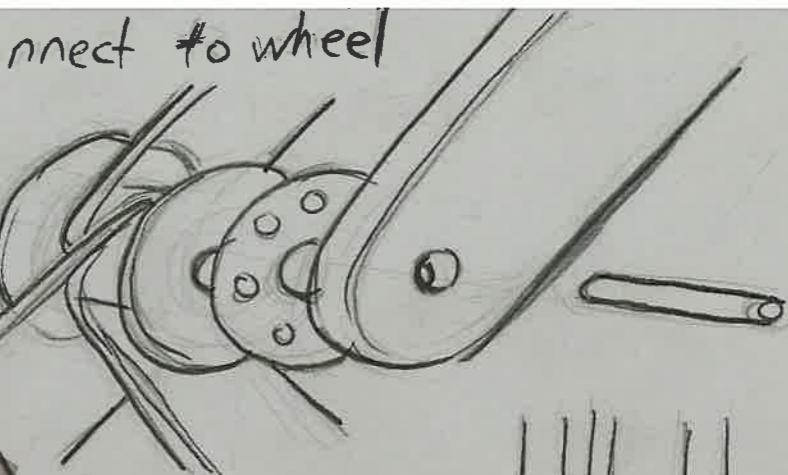
head tube



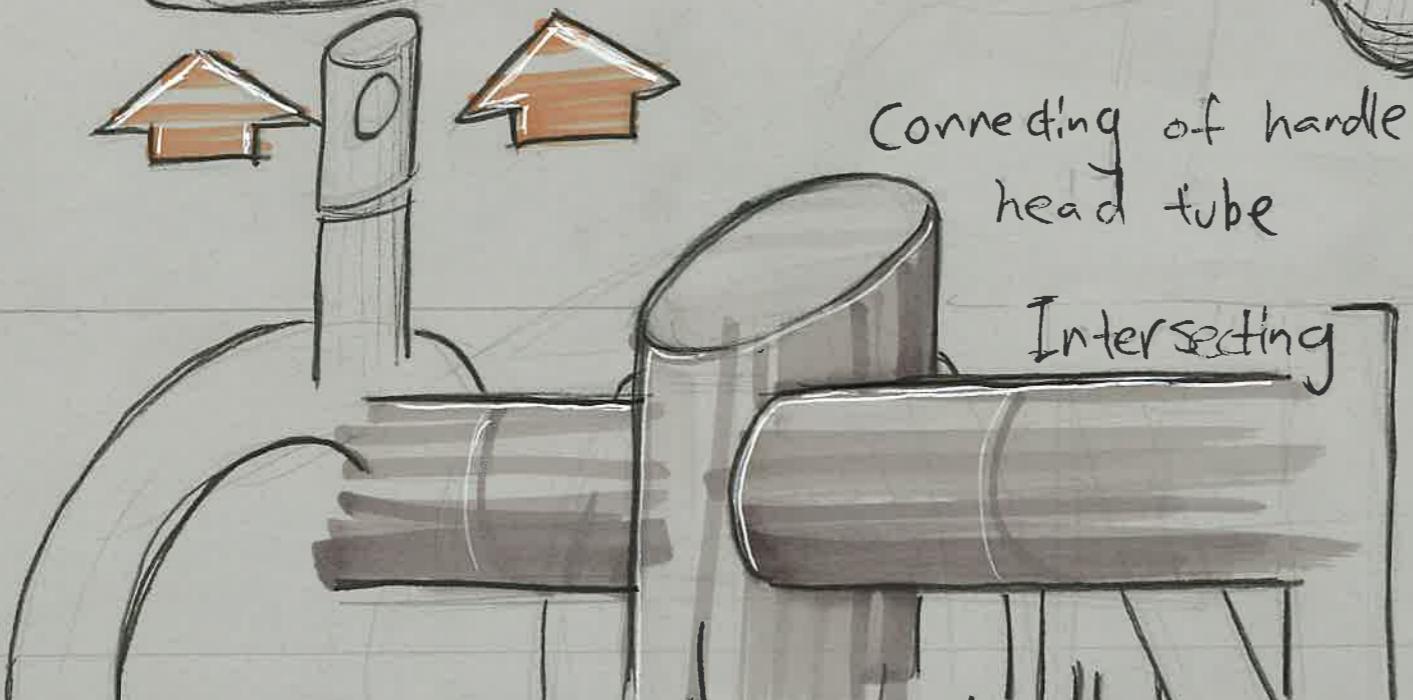
handle



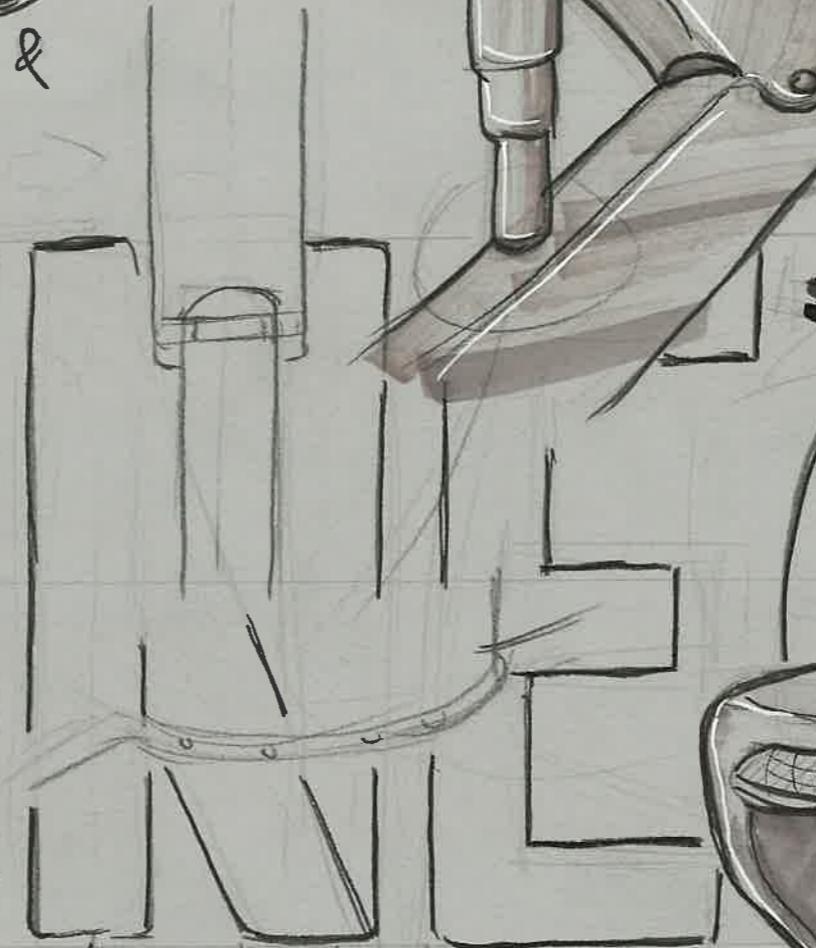
Connect to wheel



Connecting of handle & head tube



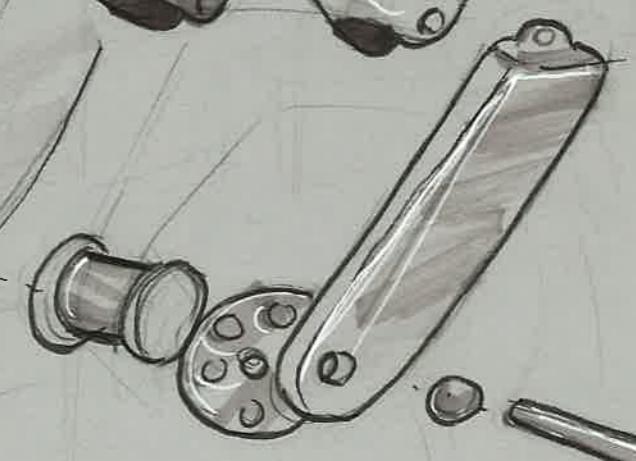
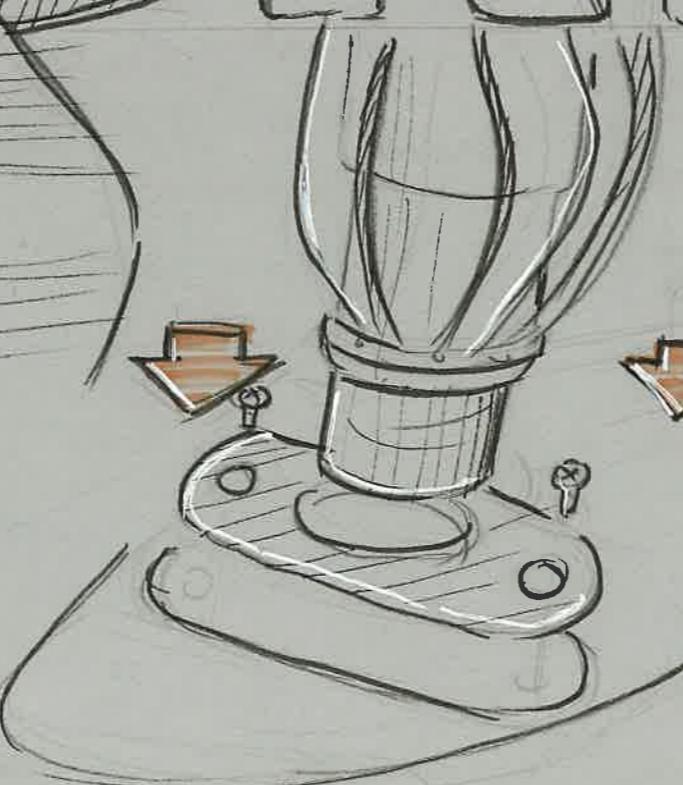
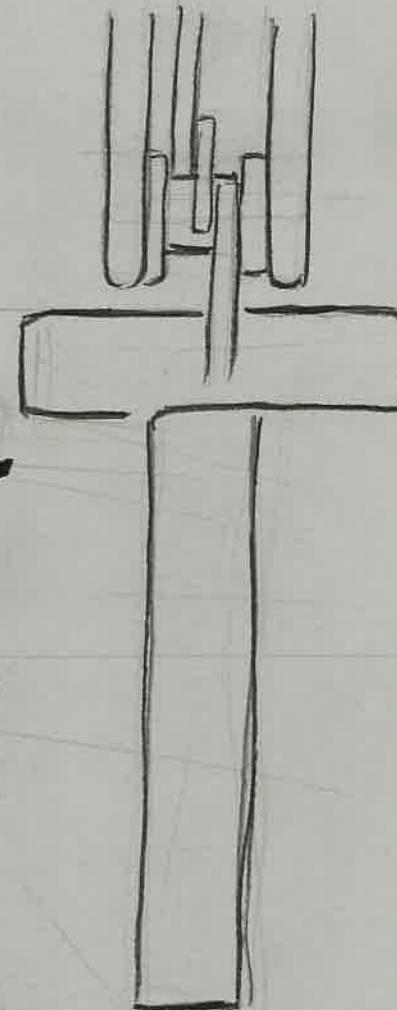
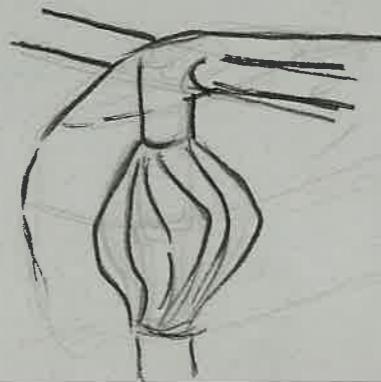
Intersecting



Front shock absorber



Screws used to connect



SHINING IN THE DARK?



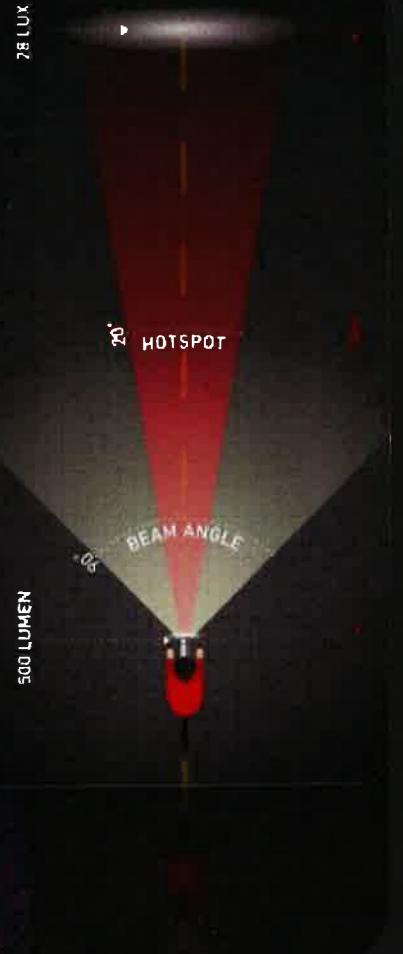
Most of the existing bicycle light are external lights hanging on the bike.

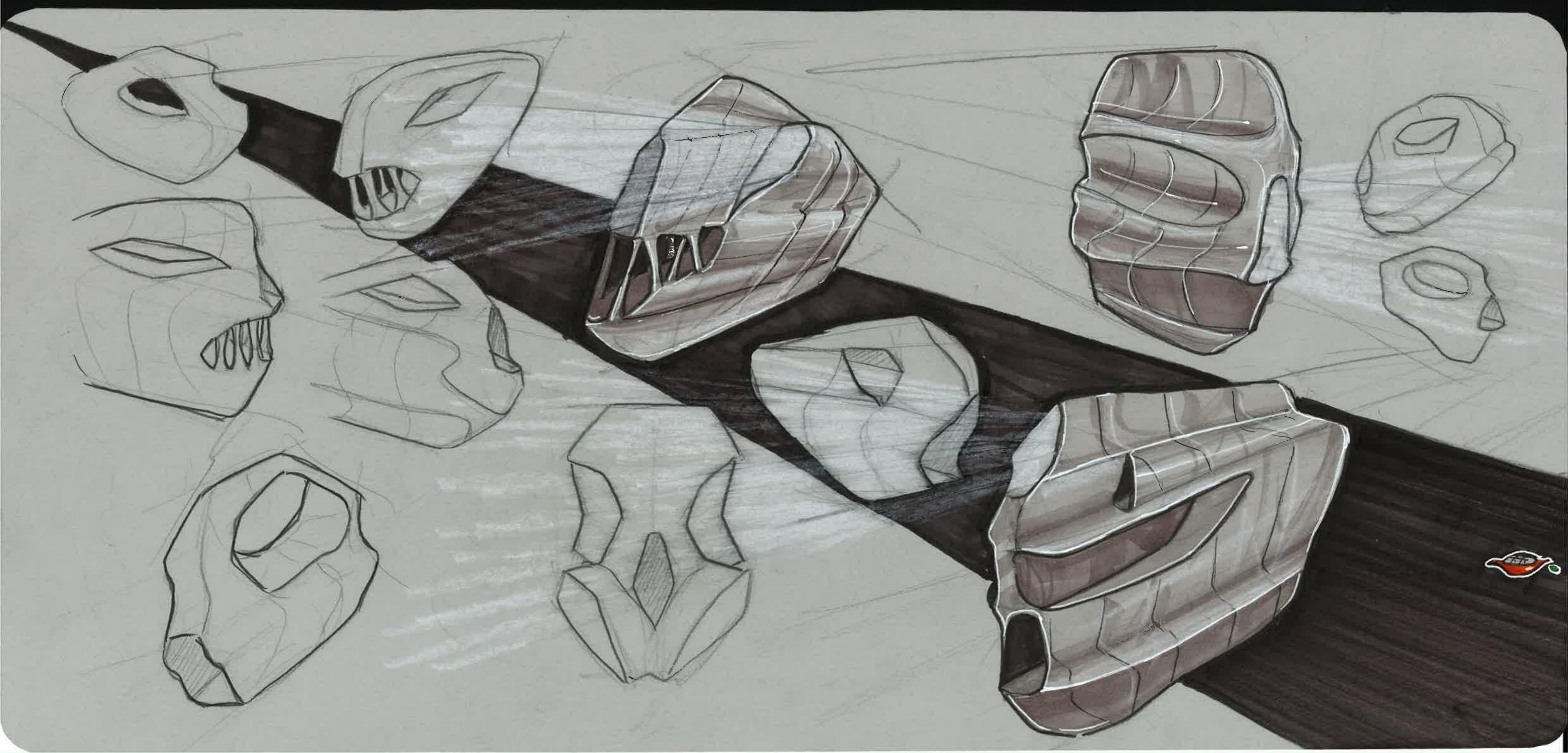
There are many different types of Bike front and rear lights .

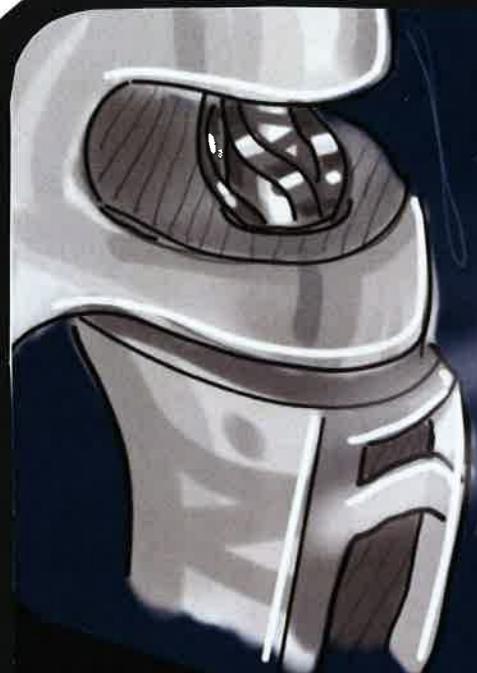


Front light are usually white and rear light are usually red

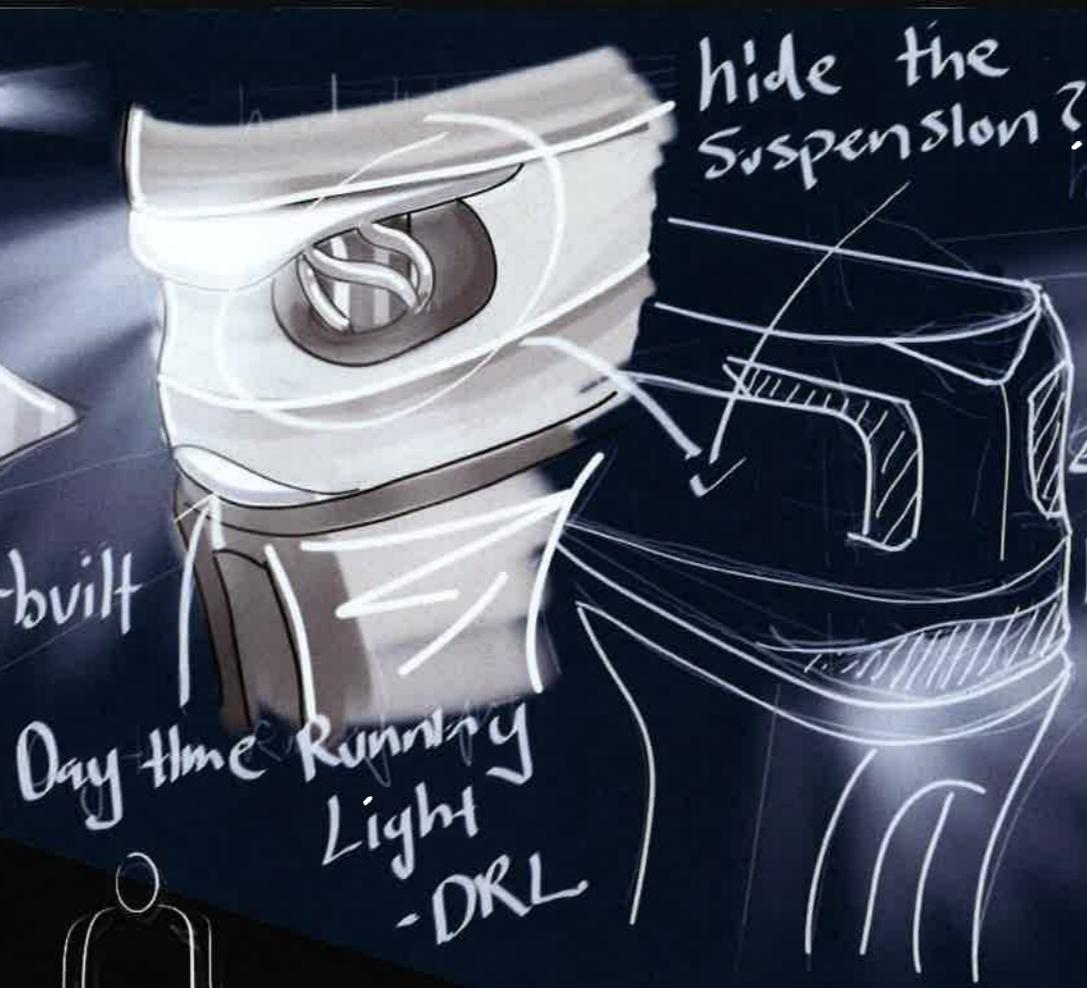
Light is necessary for night cycling; I want to design an in-built light for my bicycle light. It will integrate with the design of the bike instead of separate from the bike.



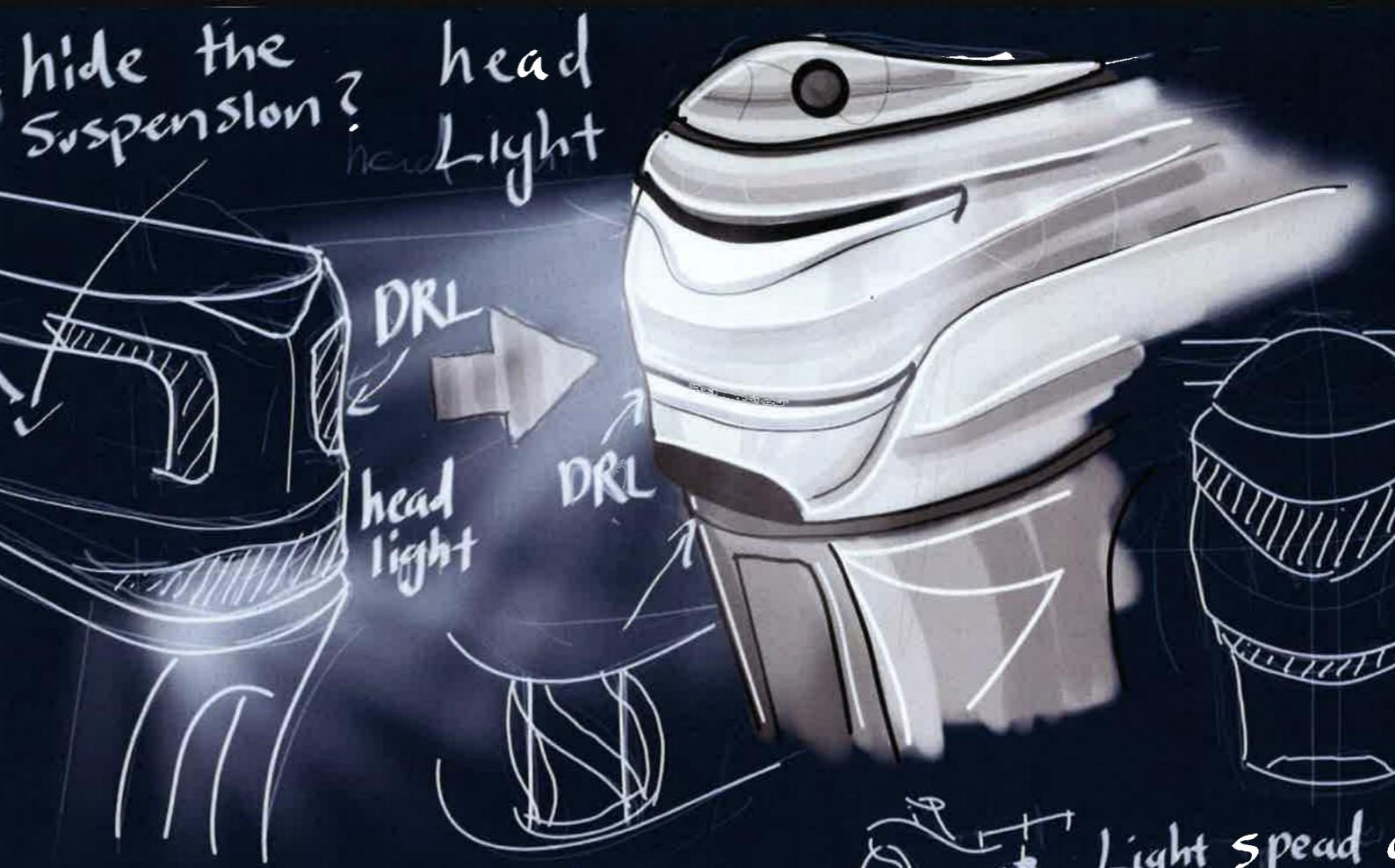




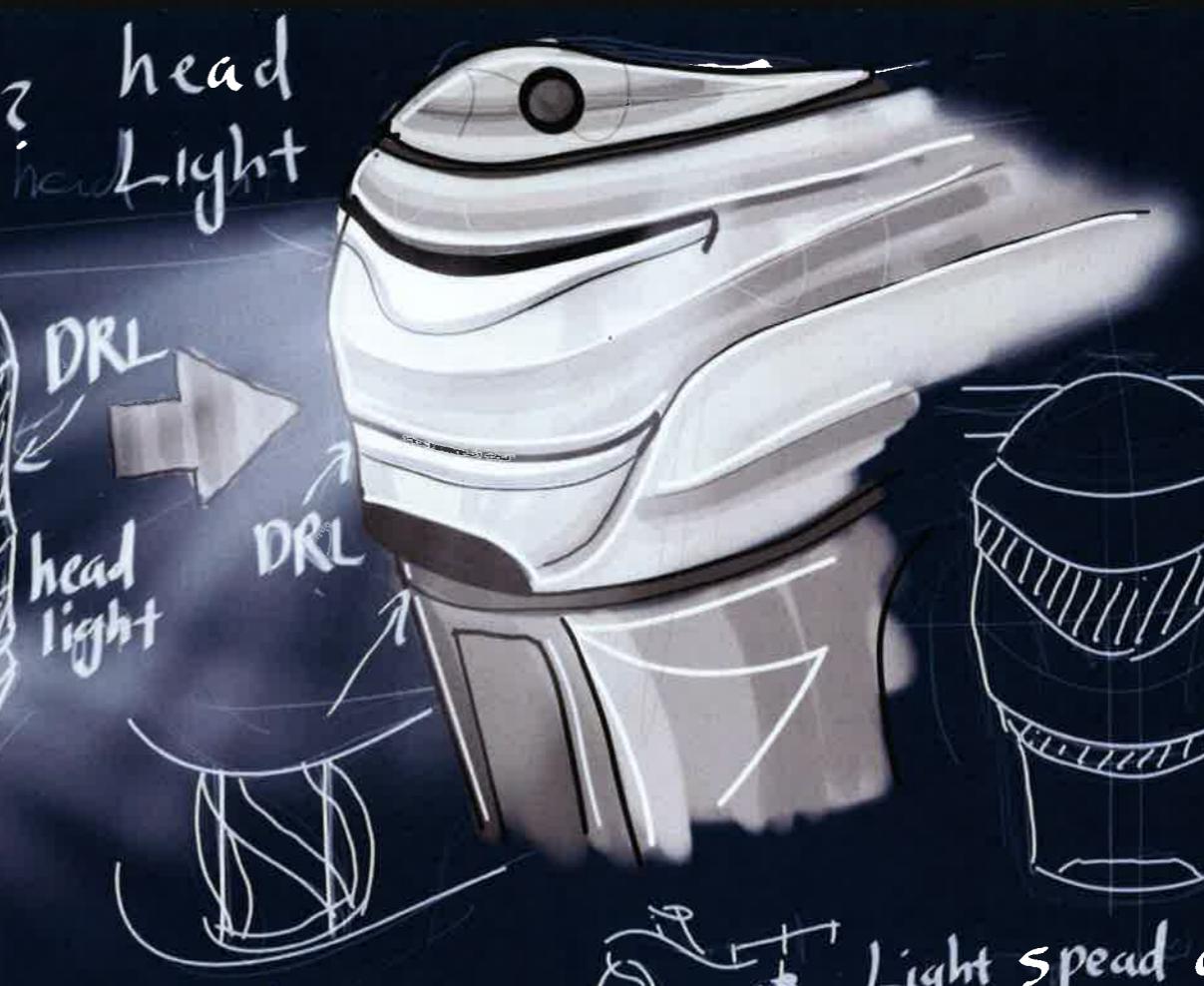
An In-built
light



Day time Running
Light - DRL



hide the
suspension? head
light



DRL



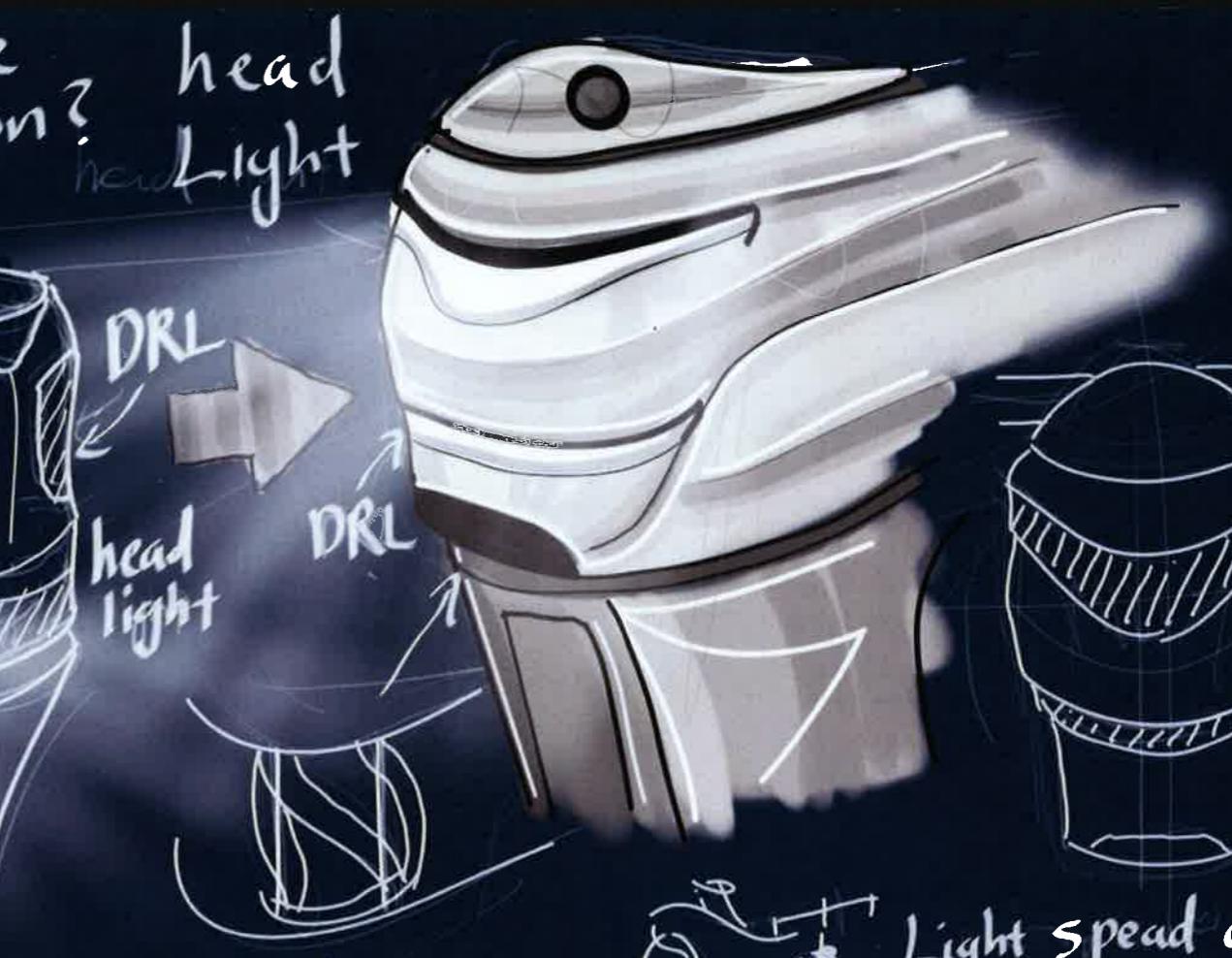
head
light



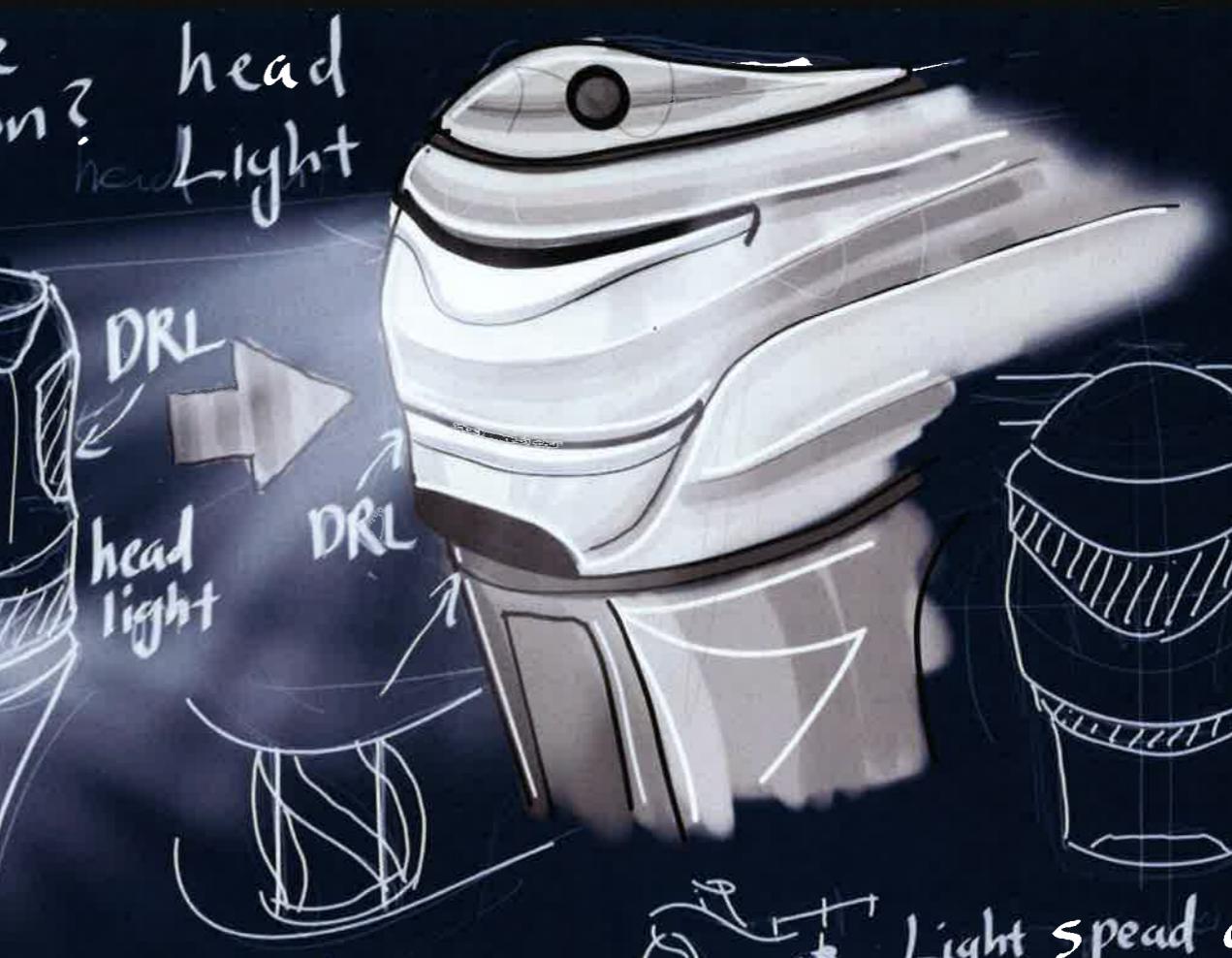
DRL



Light spread out



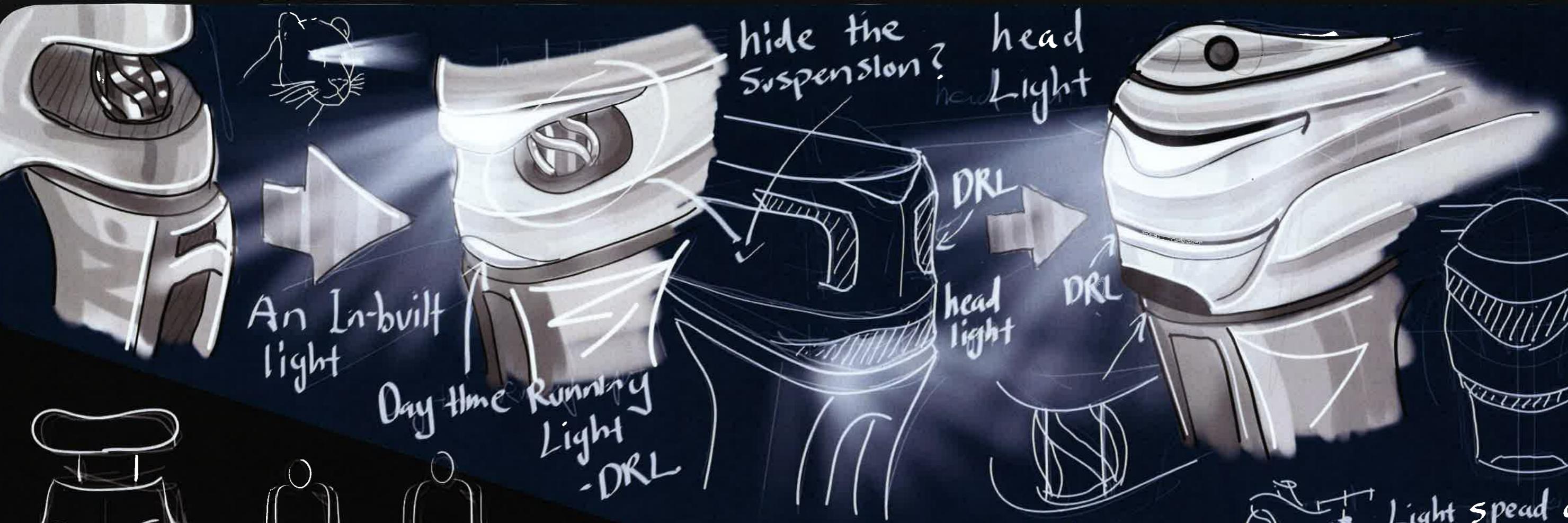
hidden under
cover.



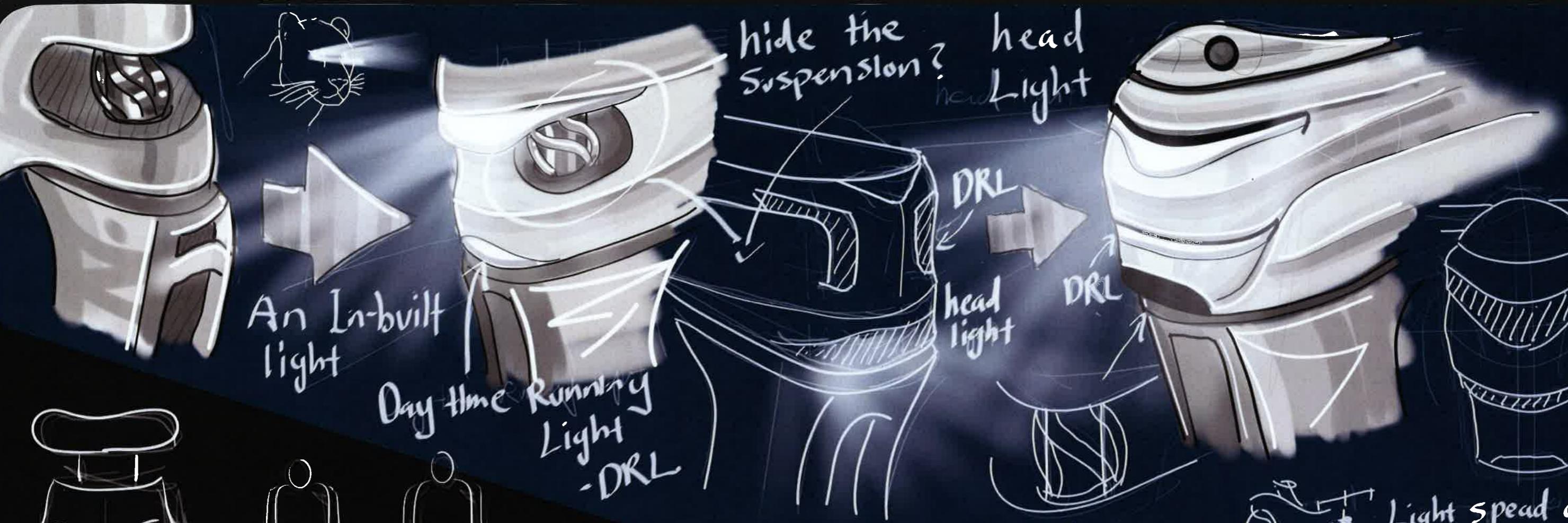
front light



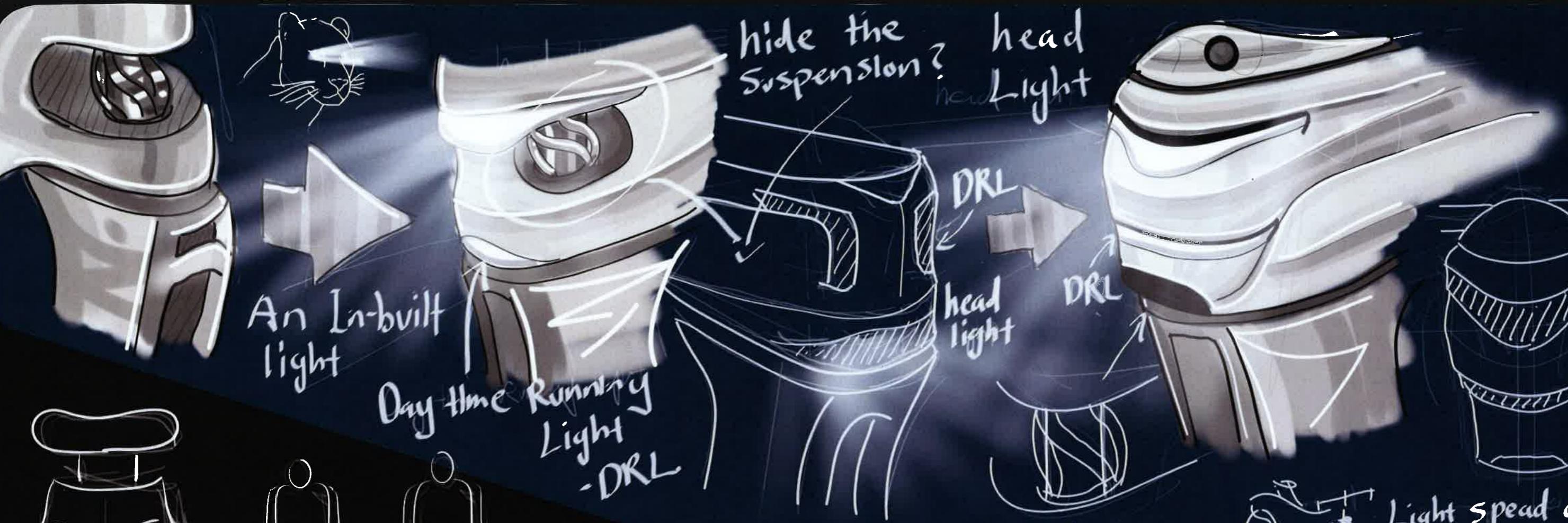
Big light
Always lighter



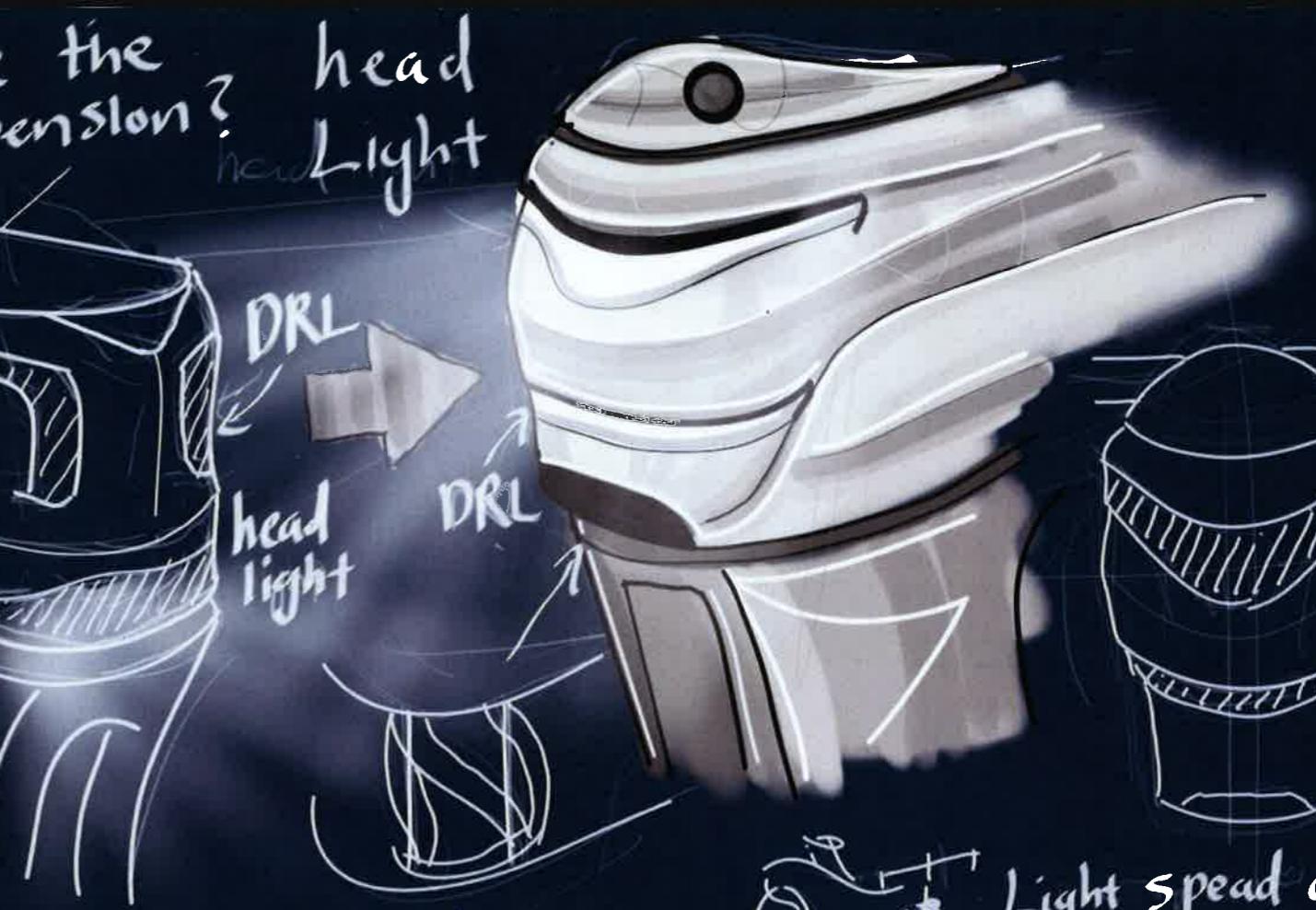
Flashing to catch attention



Flashing



Small Light



more dynamic?



Covers the
suspension?



Curved

Reflector on Bike

Light on wheel?

Light Bar instead of reflector?

Light Order when Rotating

Light Shine on side?

Light that helps other driver to see the bike.

Cold white Light in front wheel, helps other to identify the front & back of Bike.

Warm red Light in rear wheel Safer for night cycling

white

Red

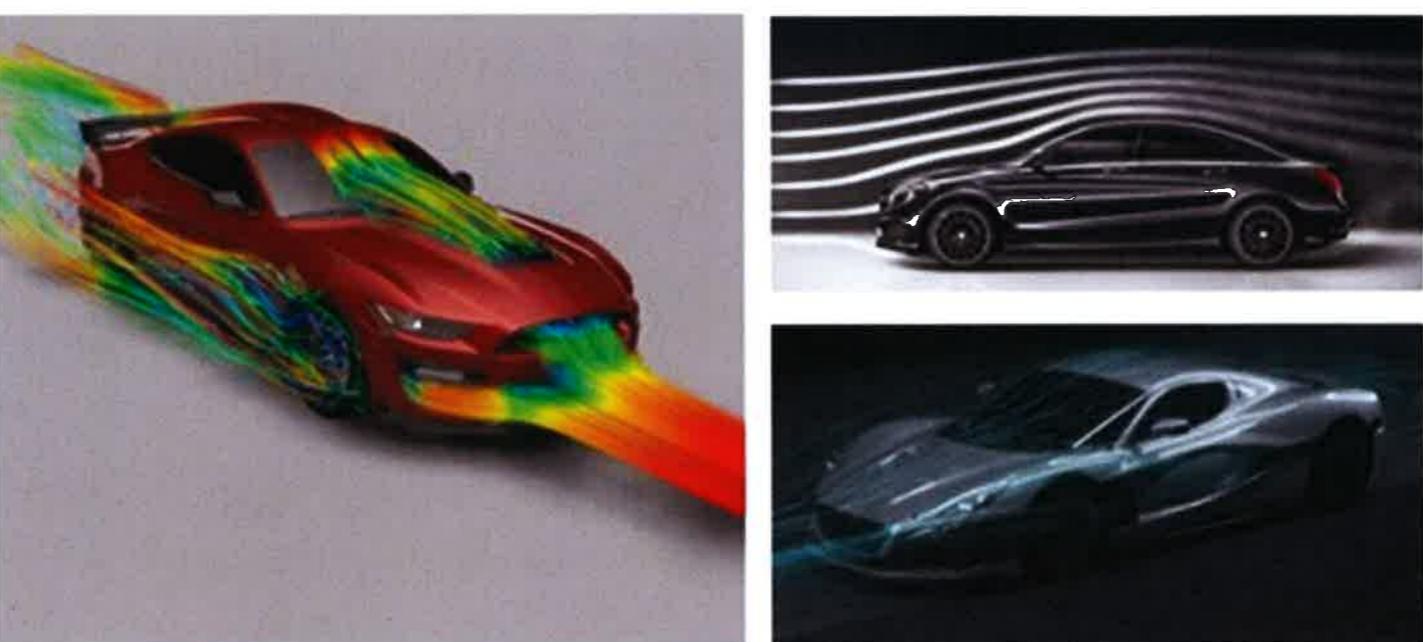
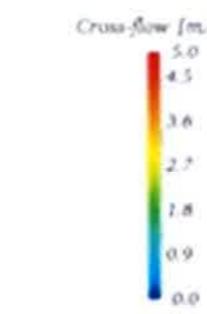
When seeing a car

At night, usually white light in front & red light in the back

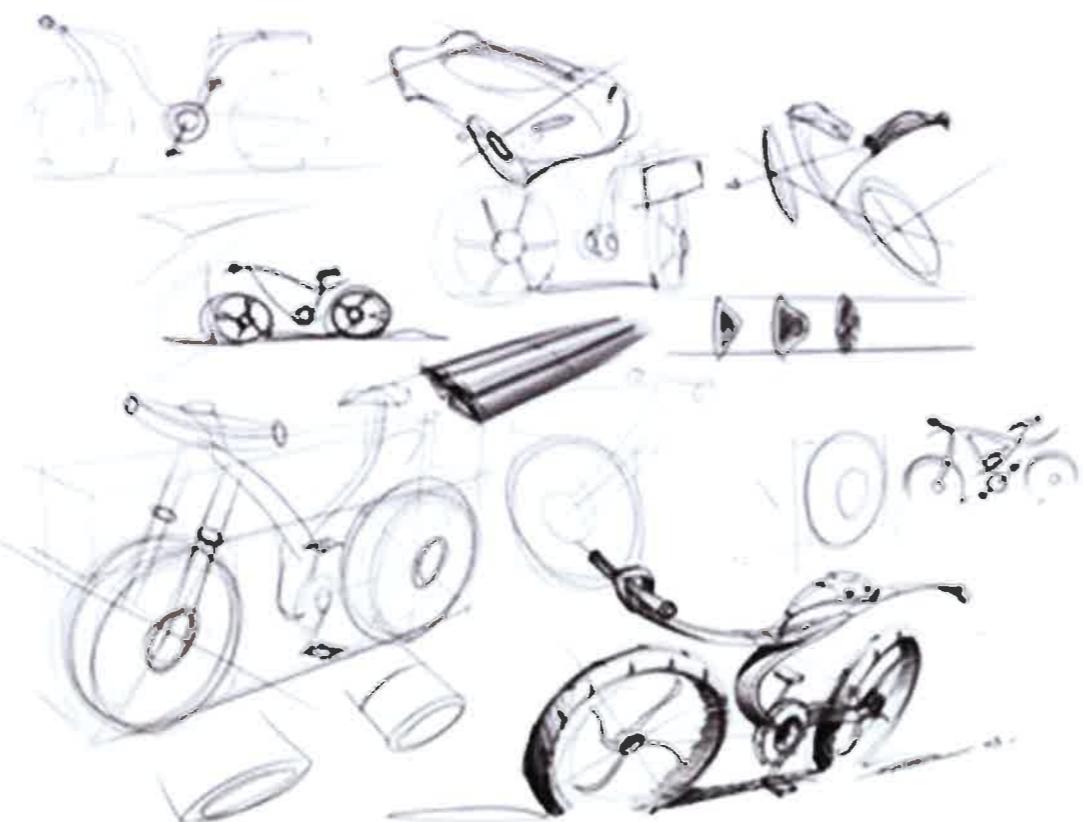
LED light

Red

Aerodynamics



Aerodynamic is a sub-field of fluid-dynamics. Aerodynamics is about to overcome the air resistance. When an object is moving, the air particles will slam into the object and creates a drag force. When a bicycle is riding faster than 30-km/h, 90% of the power goes into overcoming air resistance.

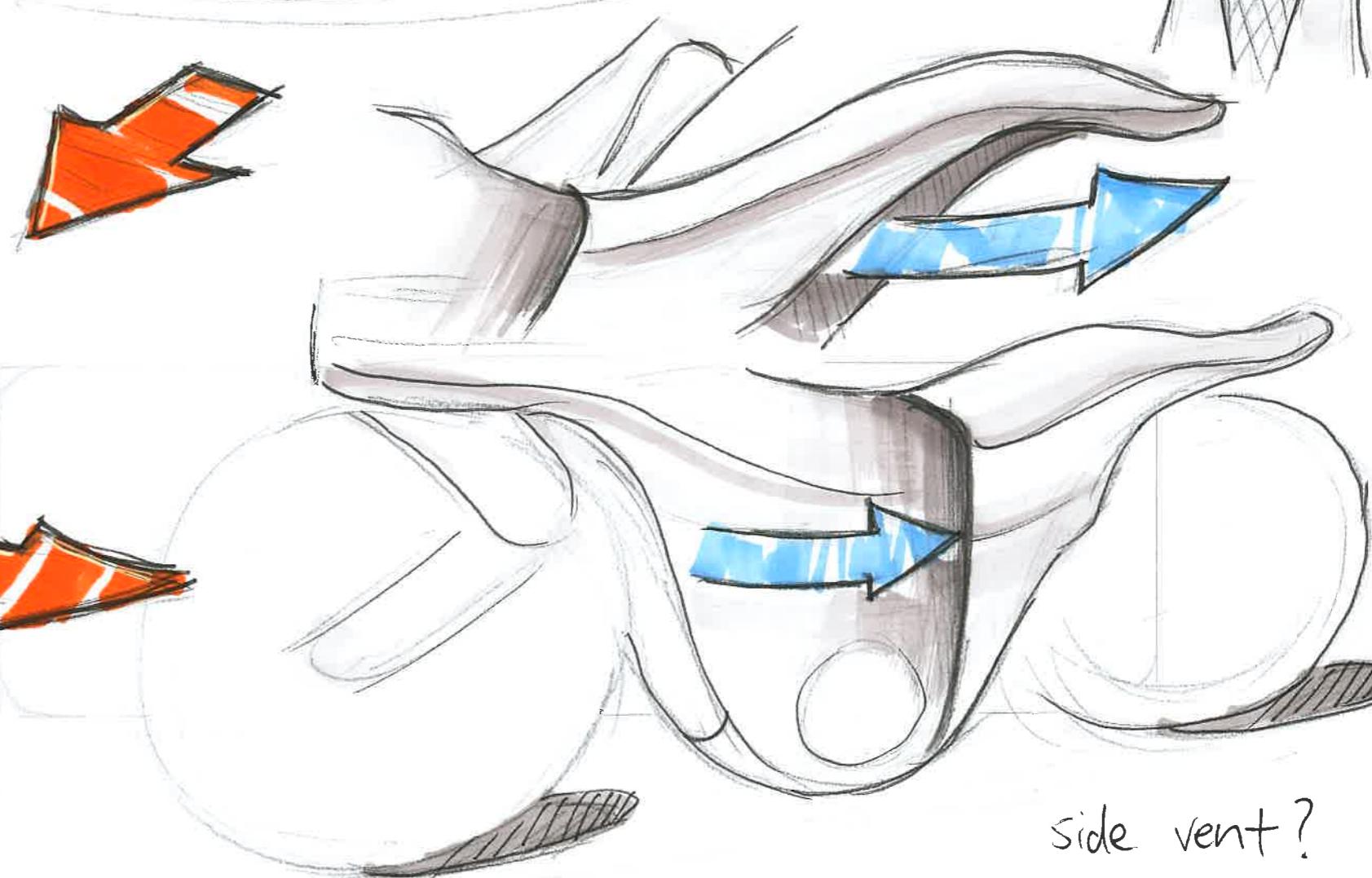
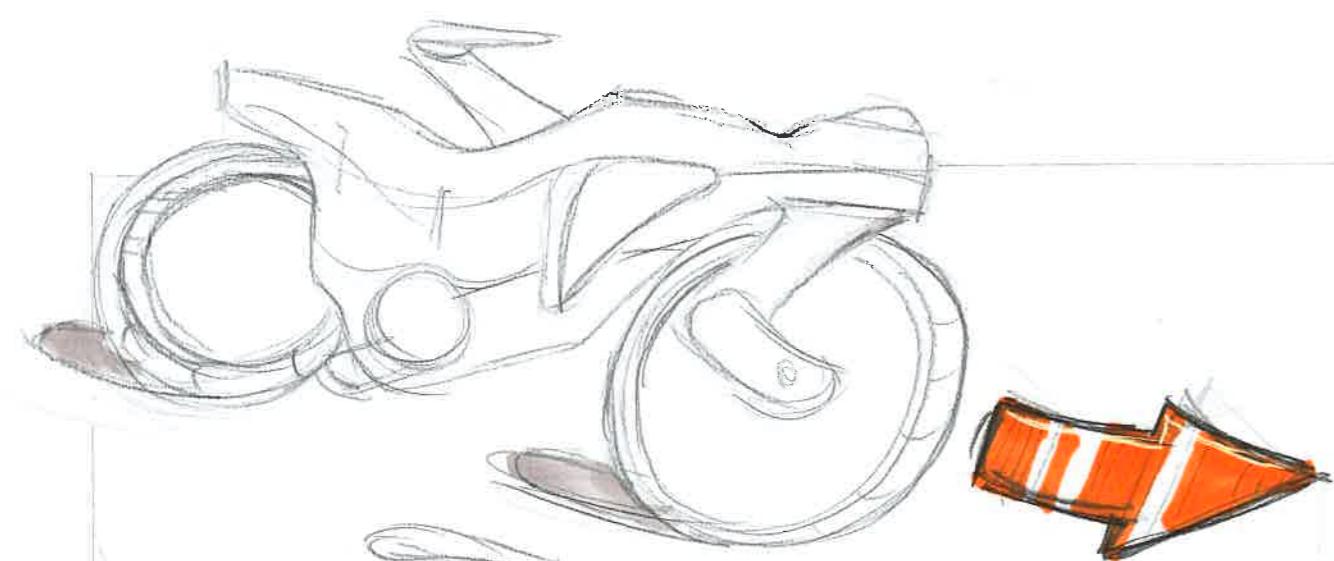


Automotive aerodynamic designs reduce the air resistance by reducing the frontal area to minimize the difference in pressure, allowing the air to flow smoothly, also creates a downforce that can improve the traction and cornering abilities.

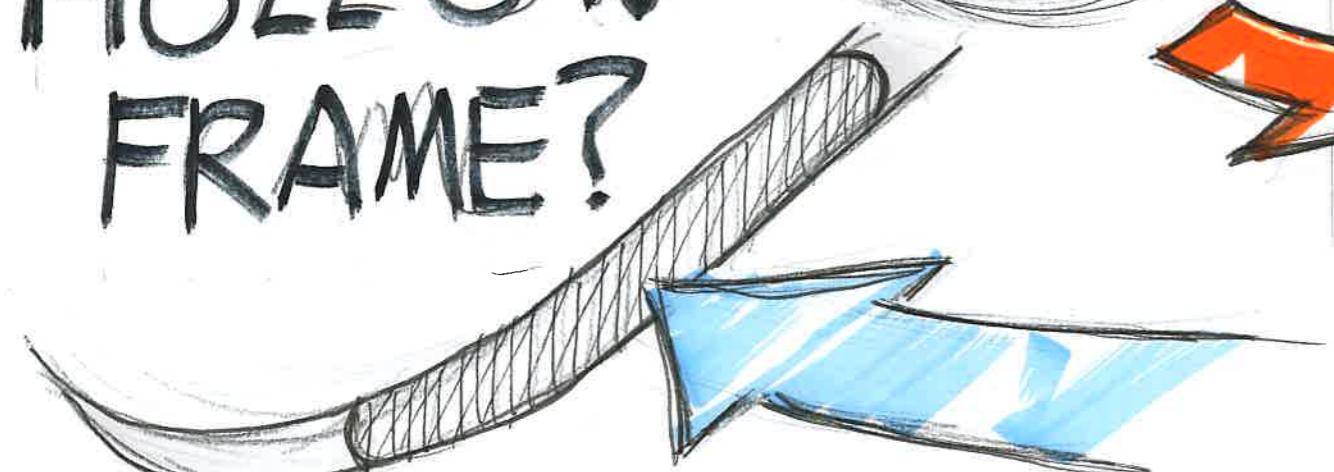
Hollow seat Post



Air flow
through
→



HOLLOW
FRAME?



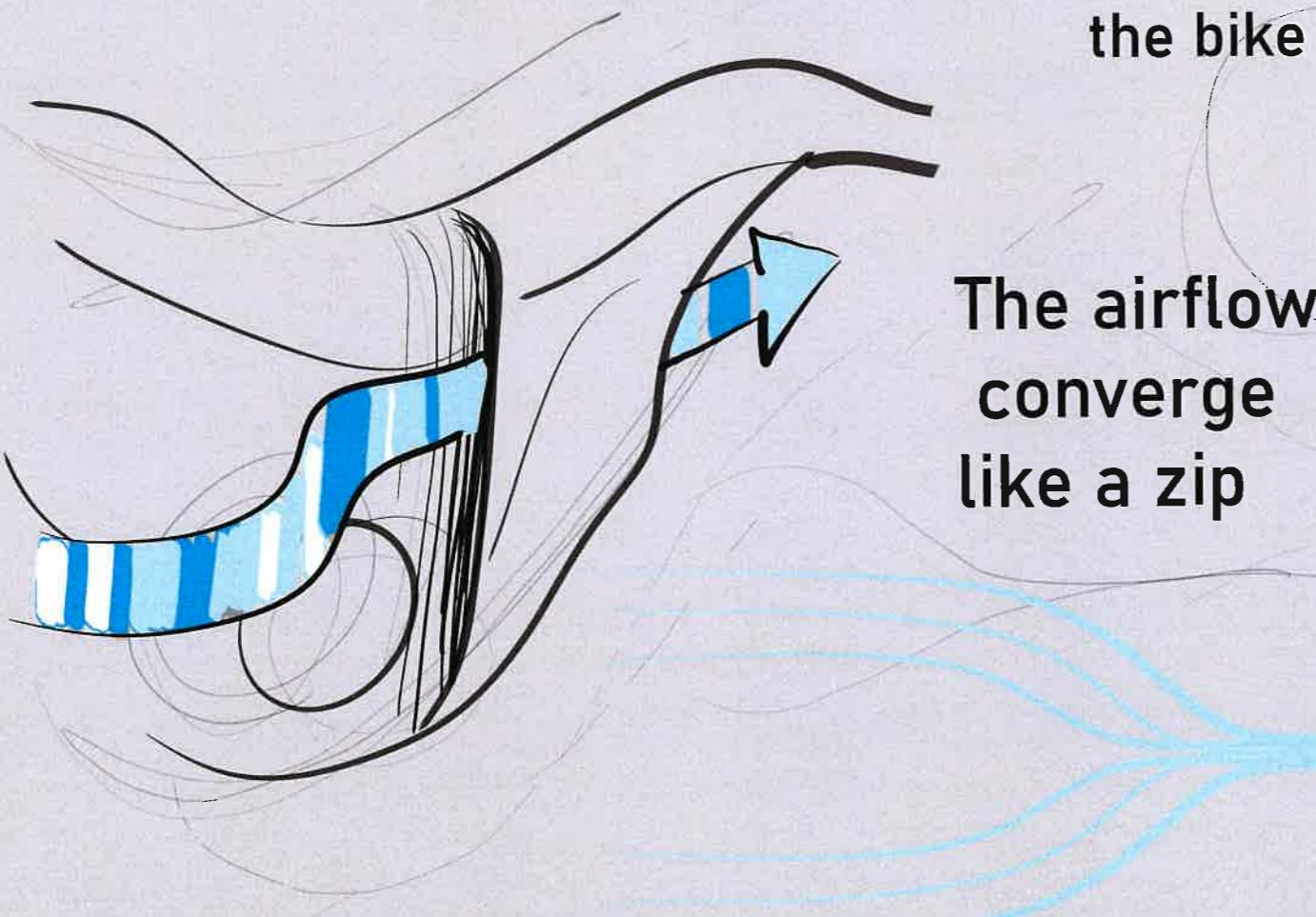
side vent?



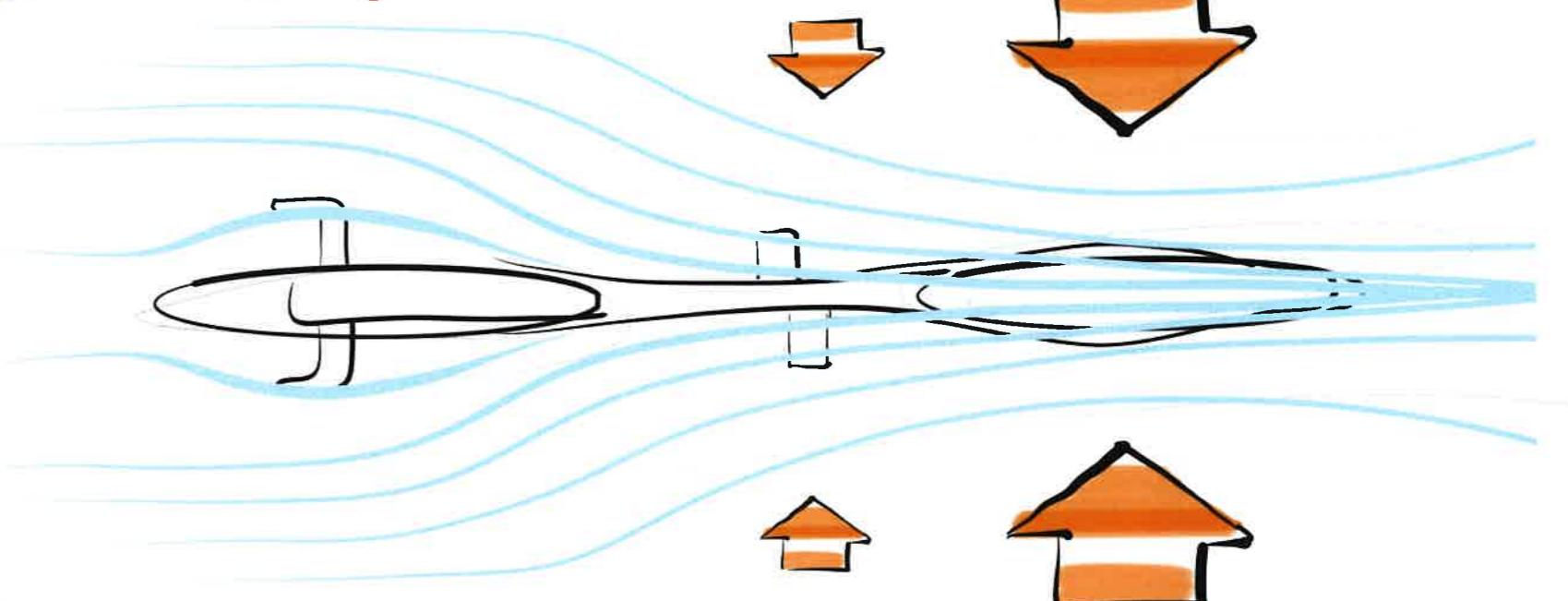
side vents on sports car
allows the air to flows through



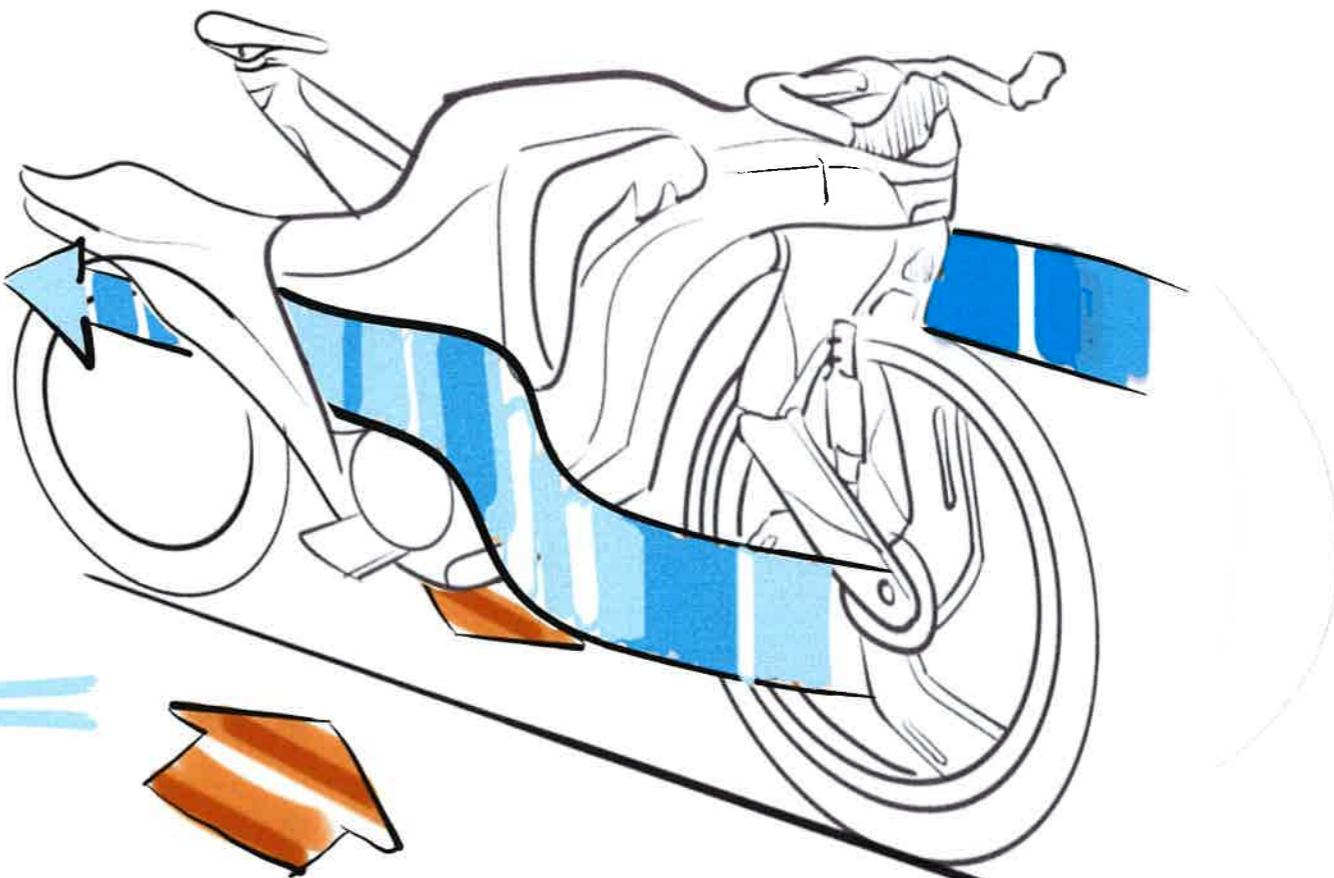
Helps to cooled
the engine and
decrease air
resistance



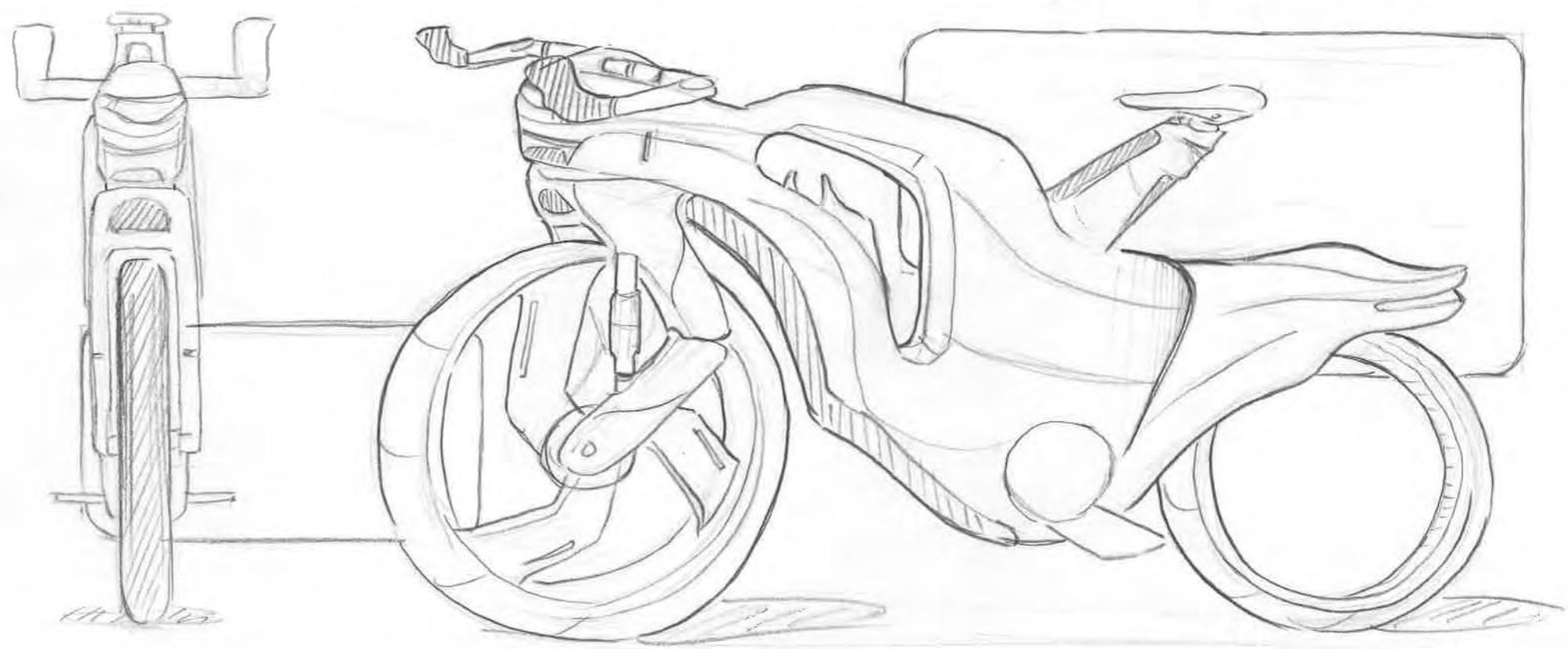
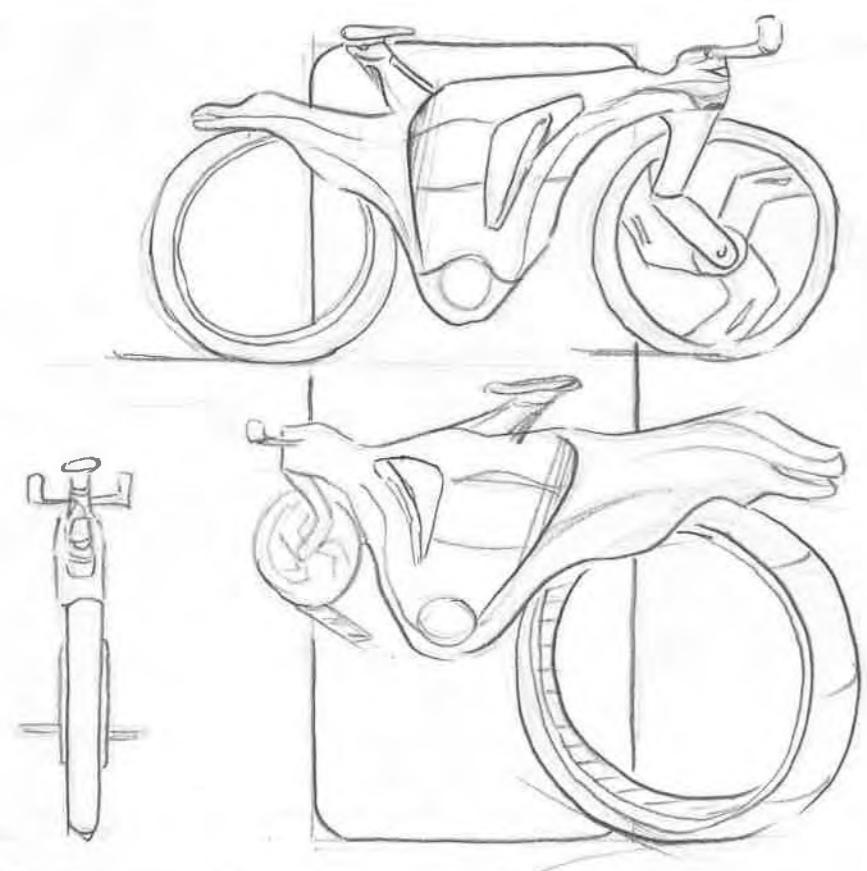
The airflow
converge
like a zip



The airflows push the bike on both side, physically assist
the bike riding in straight lines without much control needed



AERODYNAMIC - SIDE VENTS



BOTTLE HOLDER

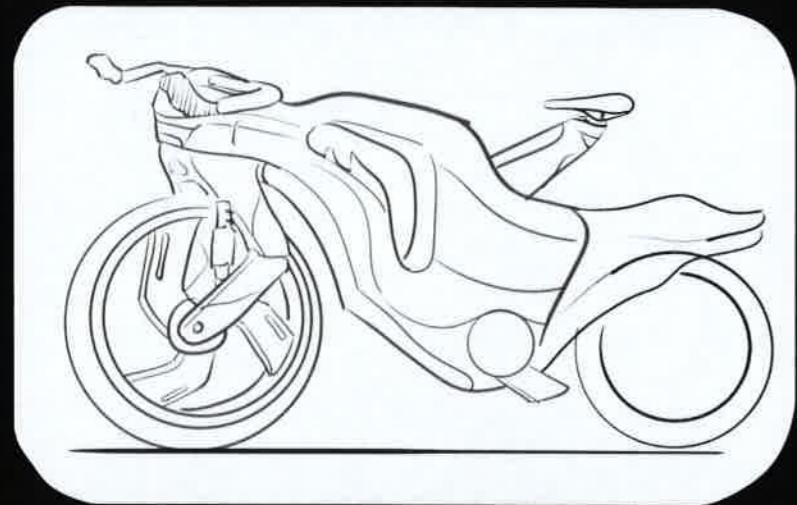


on Bike
Down tube
?



on the Seat?



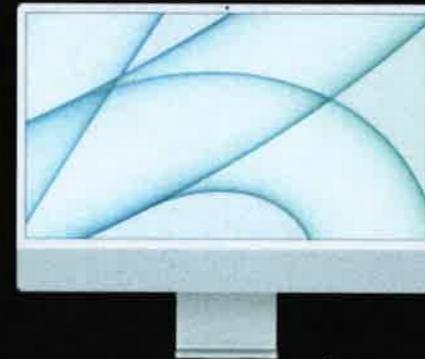


Looks too chunky?



How does other design do?

Black & white



Pure &
clean



minimalise → reduce ornament → clean → No unnecessary elements → modern simple

LESS IS MORE

functional

Abstract

Form
clour

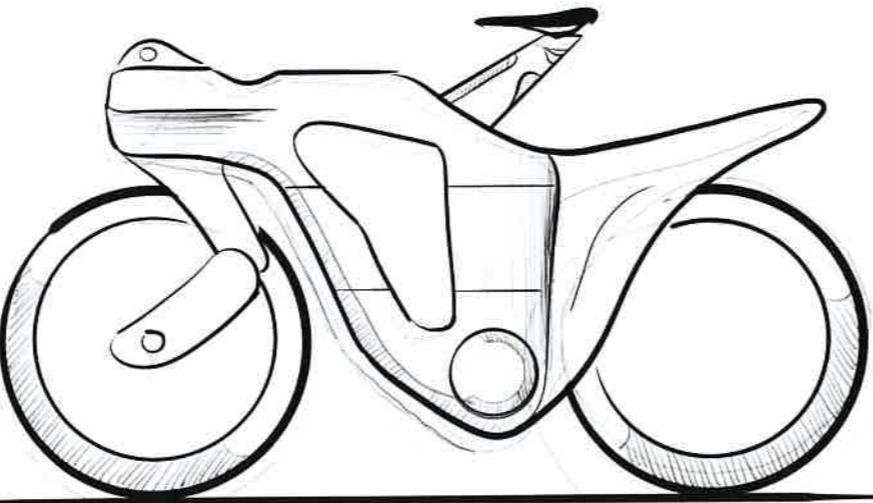
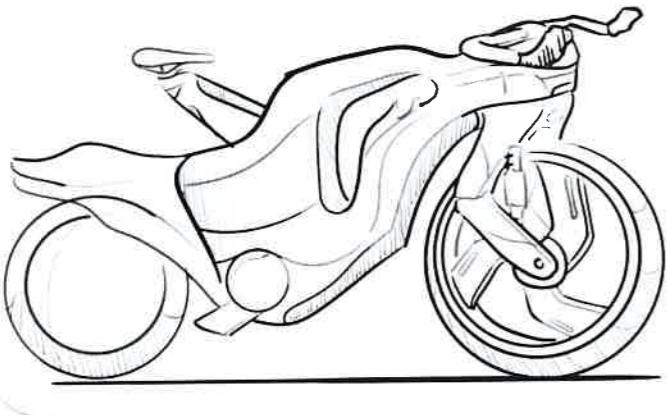
Space

minimalism

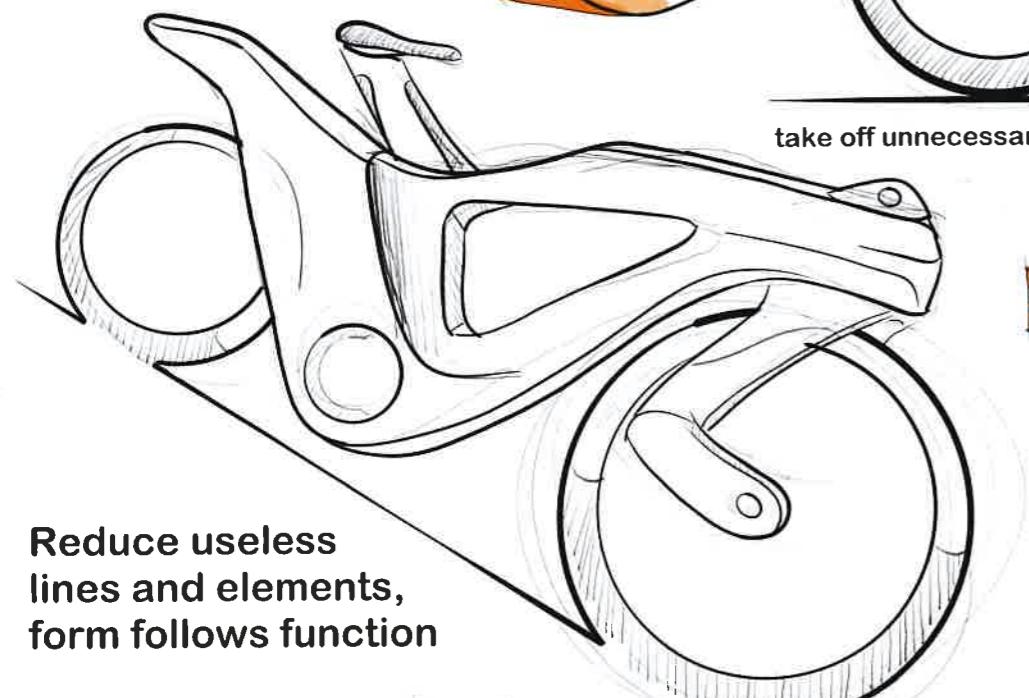
Geometric less

REFINING - AESTHETICS

Slimmer the body,
reduce the weight + less air resistance



take off unnecessary elements



Reduce useless
lines and elements,
form follows function

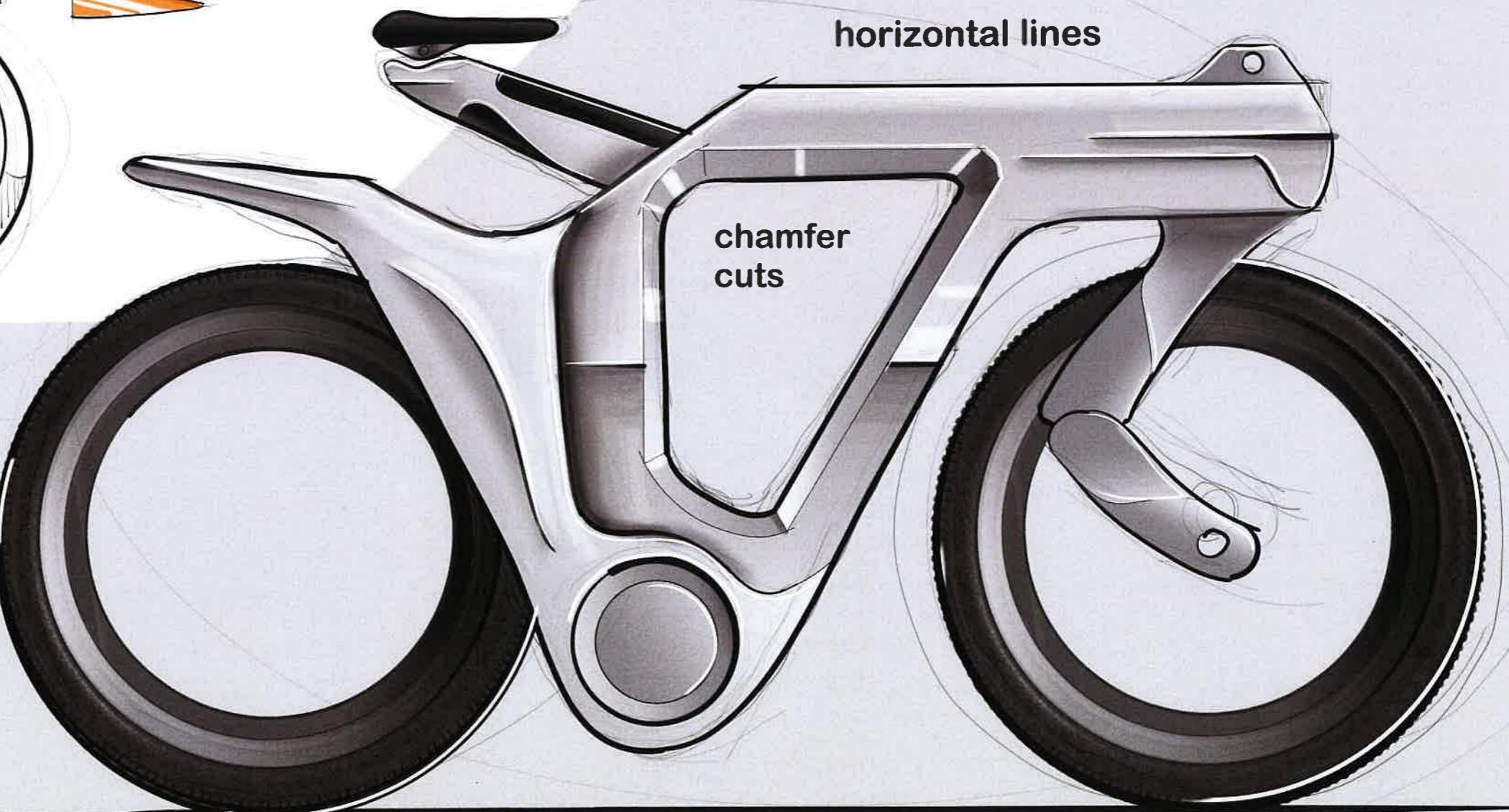


simple & clean

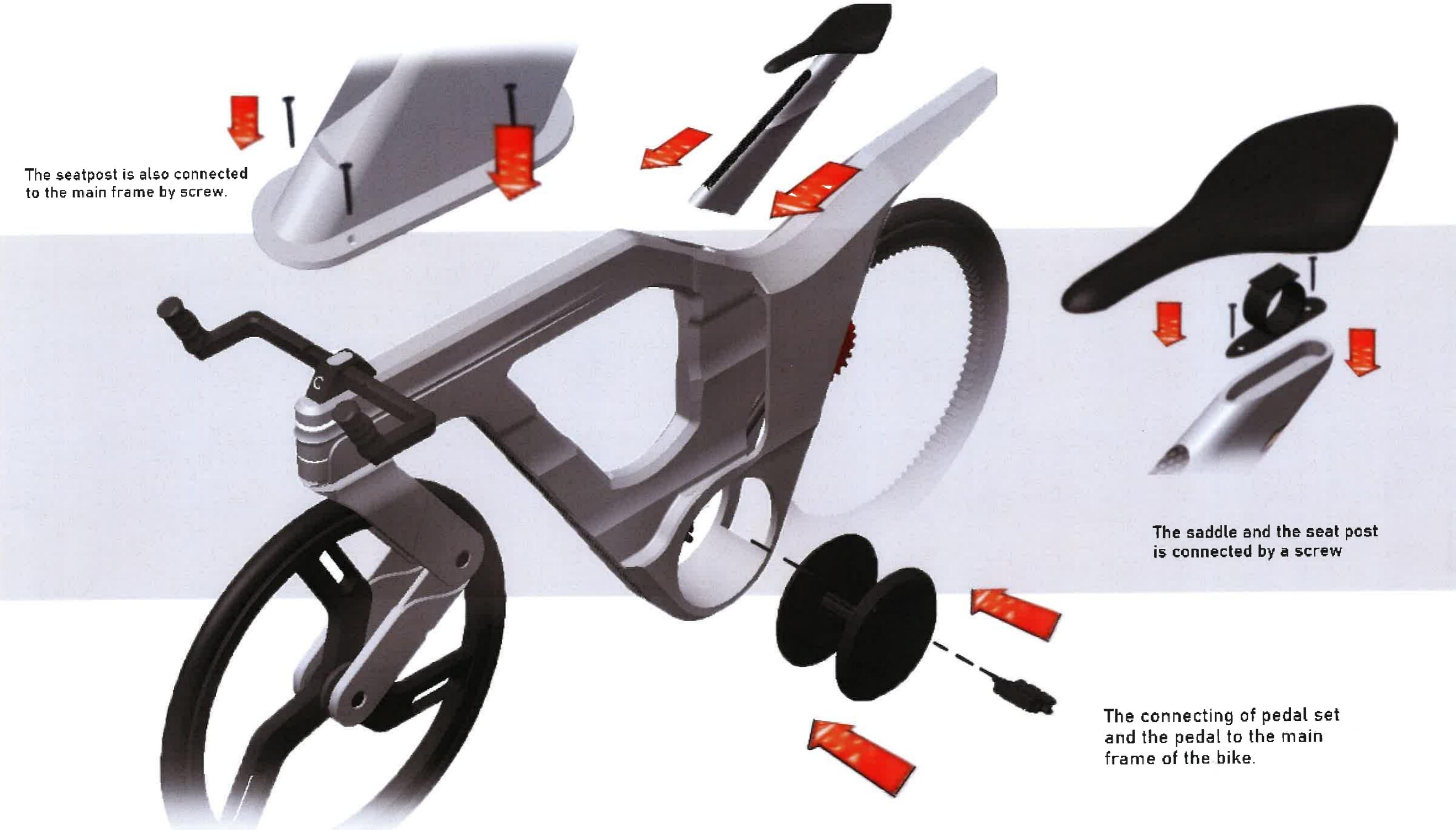
slimmer & lighter

horizontal lines

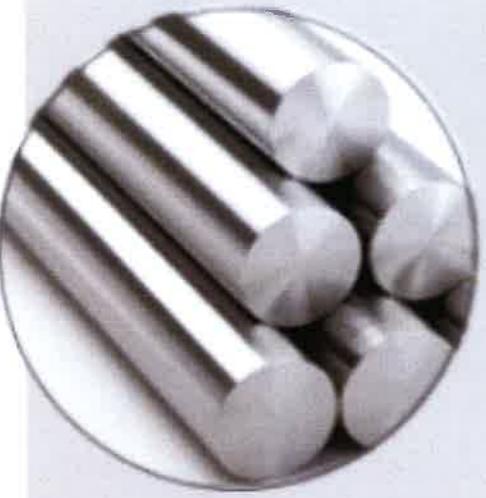
chamfer
cuts



Minimalizing unnecessary elements



DETAIL OF CONNECTING

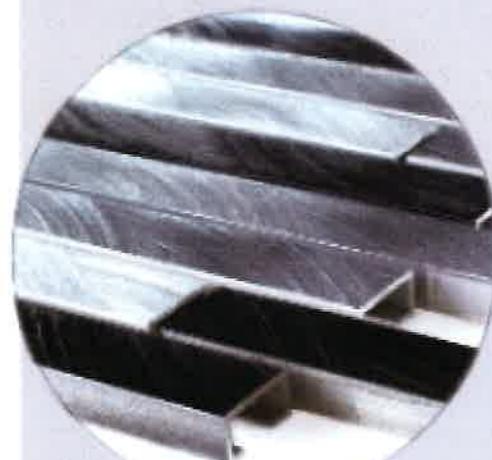


Titanium is one of the longest lasting, most expensive, strongest and most expensive frame material. Many cyclist and expert feel that it combine the best characteristic of all the other frame material. It is as comfortable as steel.

Carbon fiber is a relatively unique because it's not a metal. It is a fabric that's impregnated with a glue called resin that allows shaping and joining the material. Carbon frames are extremely light, stiff and durable. Its greatest advantage is that can be manipulated essentially in endless way.



Aluminum is the lightest frame material, even lighter than carbon and titanium. Aluminum frame is great choice for racing and time trialing. Unlike steel, it won't rust. Aluminium fork are stiff and light, and can be shaped aerodynamically. They also offer excellent compliance for comfort on rough roads.



The most traditional frame material, many types of steel tubing are available and the material is easy to bend and shape. It's plenty strong and it also absorbs shock to soften rough road. Steel forks are heavier than those built of lighter material such as aluminum and carbon fiber.



I decide to use a type of steel called Chromoly Steel, it is lighter than regular steel, more flexible than aluminium, more cost efficient than titanium and the perfect material for bike. It is resistance to extreme temperature. It also maintains similar strength as steel. This translates to sleeker frame, faster speed and comfortable maneuverability. Chromoly steel is naturally shock-absorbent. Instead of adding bulky shocks to your front wheel, or worse, jettisoning along with every bump and crack along the way, the frame itself catches unpleasant road vibration.



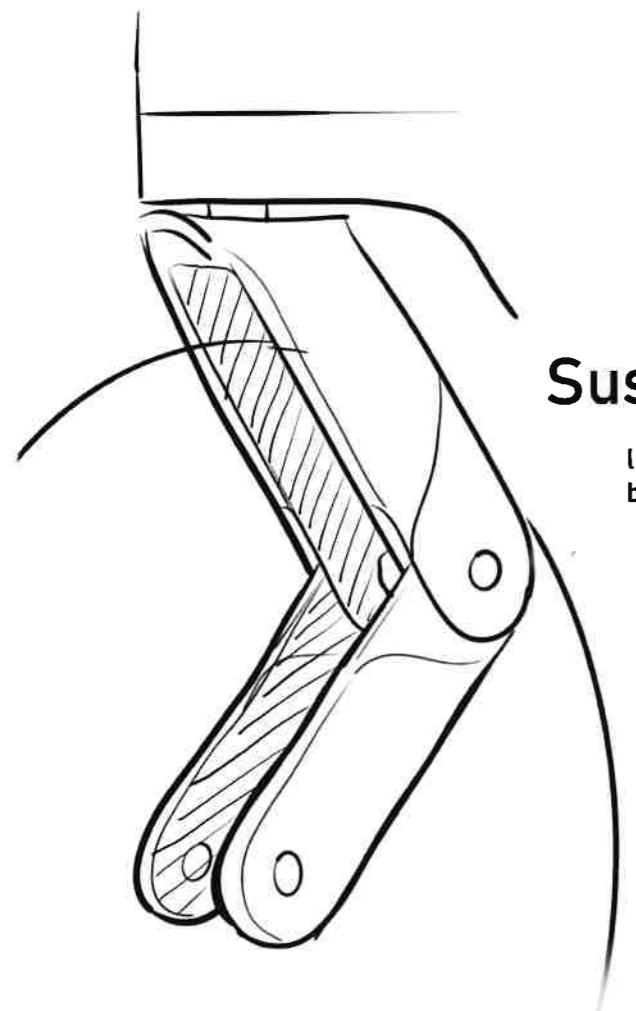
I decide to use aluminum as it is the lightest frame material. The fork will be stiff and light using the aluminum, it is also easier to shape into the form.



MATERIAL-BIKE FRAME

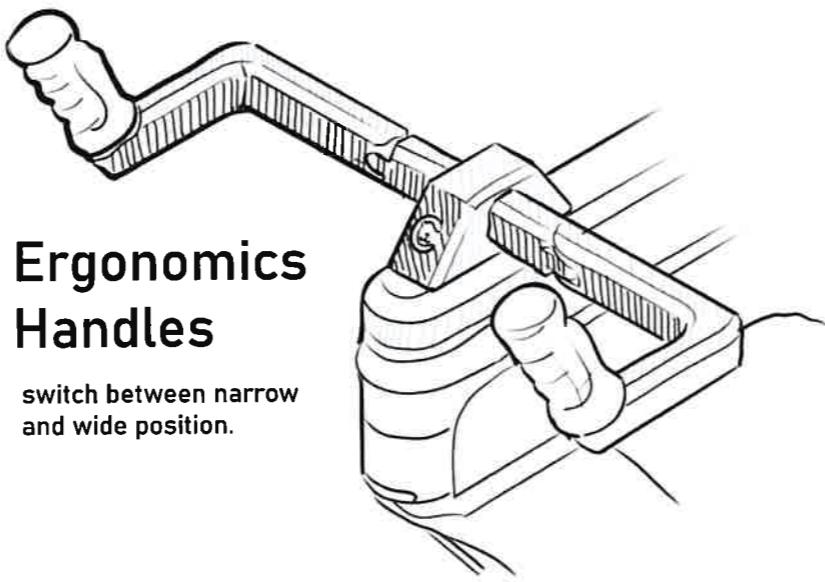
Curve Lines

from the body lines of leopard



Suspension

like the leg of leopard
bends when landing



Ergonomics Handles

switch between narrow
and wide position.



Aerodynamic

Air flows through smoothly



SUMMARIES

It is suitable for both mountain and road cycling. The ergonomic handle is modelled from the actual human hand data. The size and the proportion of each part are precisely calculated and considered to ensure the comfort of long time riding. The handle can switch from wide to narrow for road cycling and mountain cycling. The bike's frame is hollowed, with honey cone ventilation reducing the air resistance while preventing rocks from stuck inside the bike frame. The horizontal cuts on the frame are designed for better aerodynamics, with a bionic front-wheel suspension inspired by the leopard landing motion. The unique design of the rear-wheel abandoned the traditional. It bikes design and uses bevel gear for driving instead. It is an extraordinary modern bicycle that fits the new era of industrial design for everyone who loves cycling.

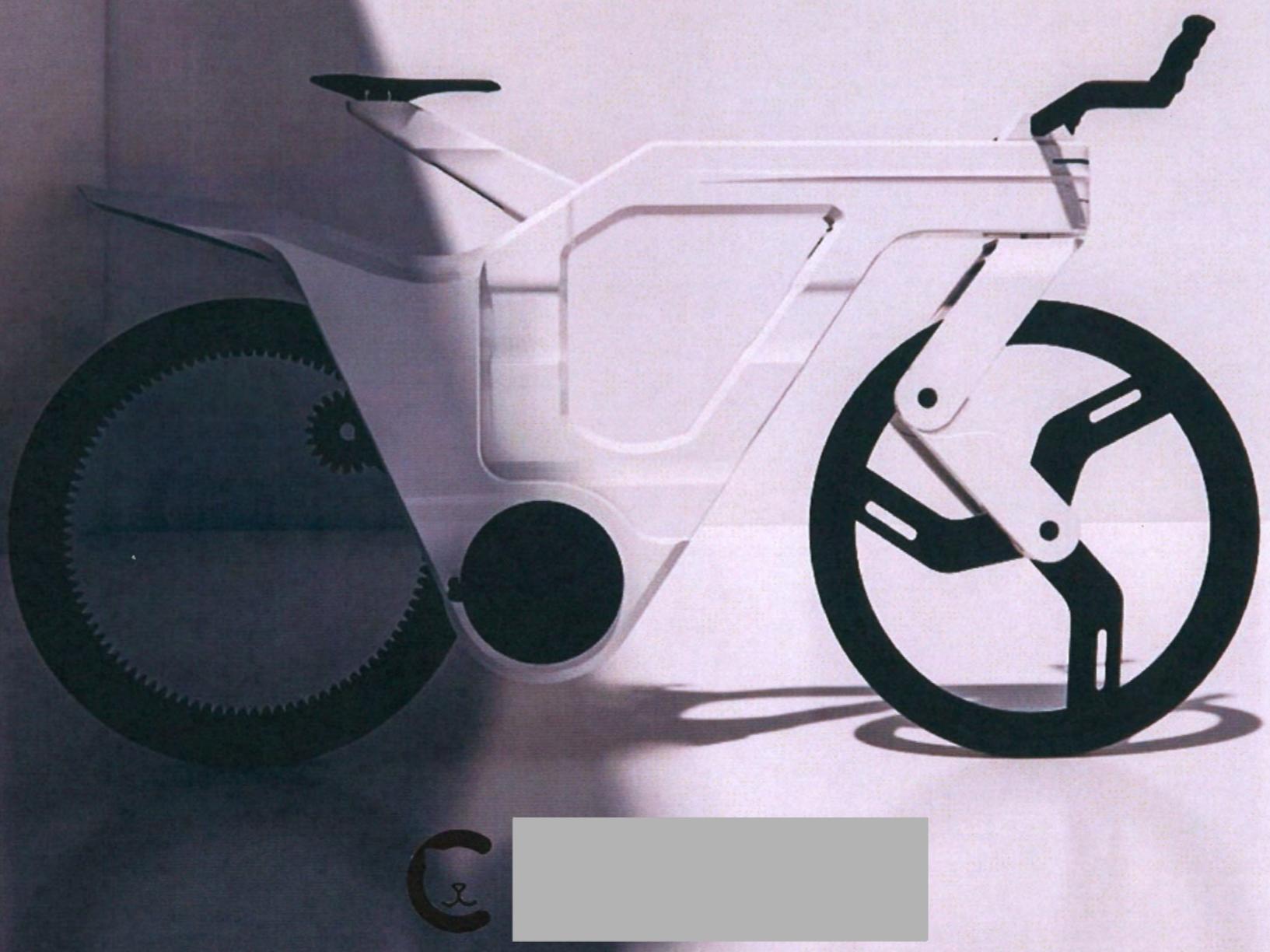


SSS
SPEED
STABILITY
SAFETY

EVALUATION

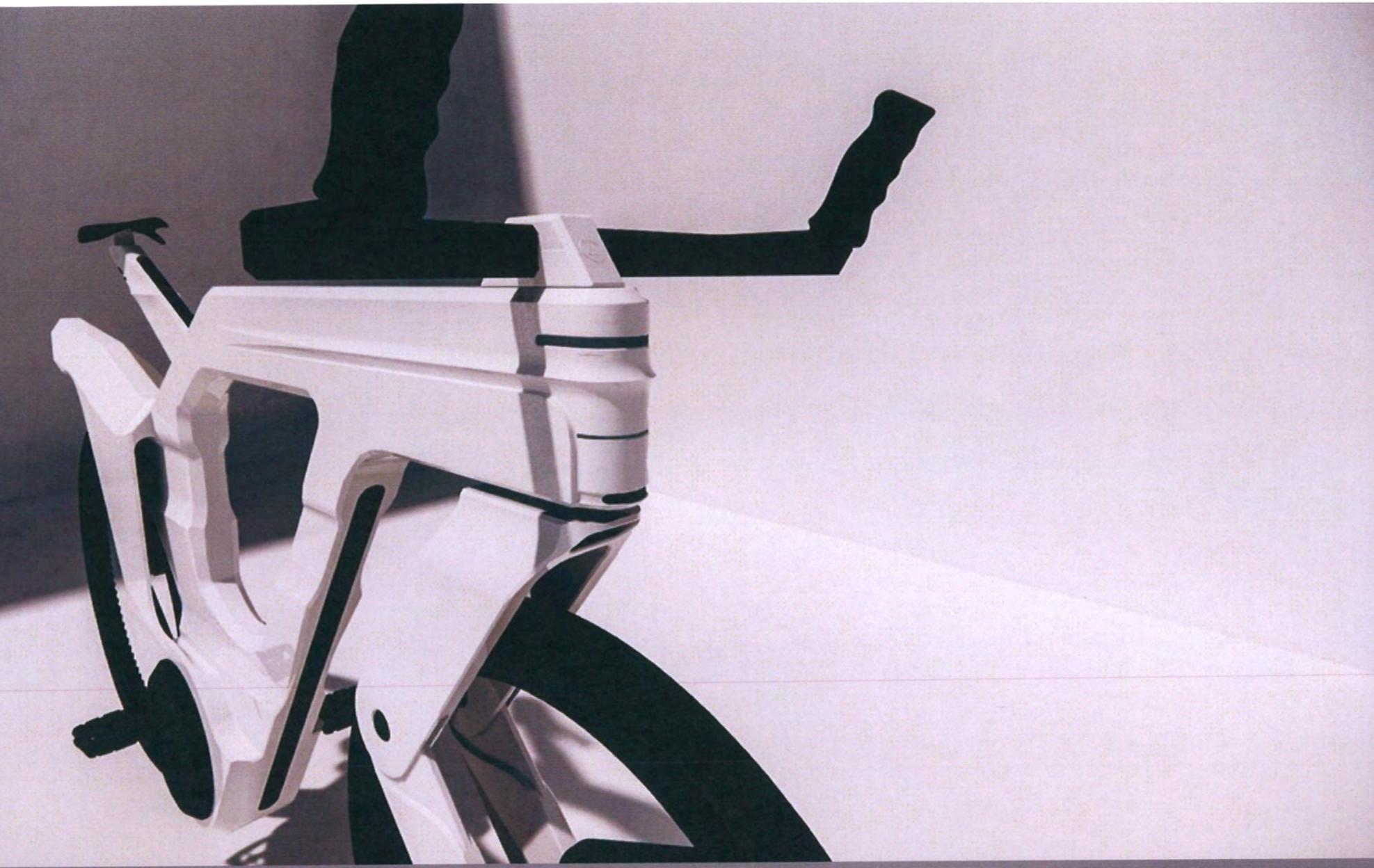
MEETING THE SPECIFICATIONS

- Flow & Minimalistic appearance that contains modern aesthetic appeal.
- Using material such as microcellular rubber, carbon fibre, and switchable handle suitable for the different cycling environments.
- Accurate proportion and ergonomic handle for comfort.
- Hollow frame and lightest material-aluminium to control the weight and ensure durability.
- Contain two headlights and two rear lights for safe nighttime cycling.
- Bionic shock absorber and suspension system.



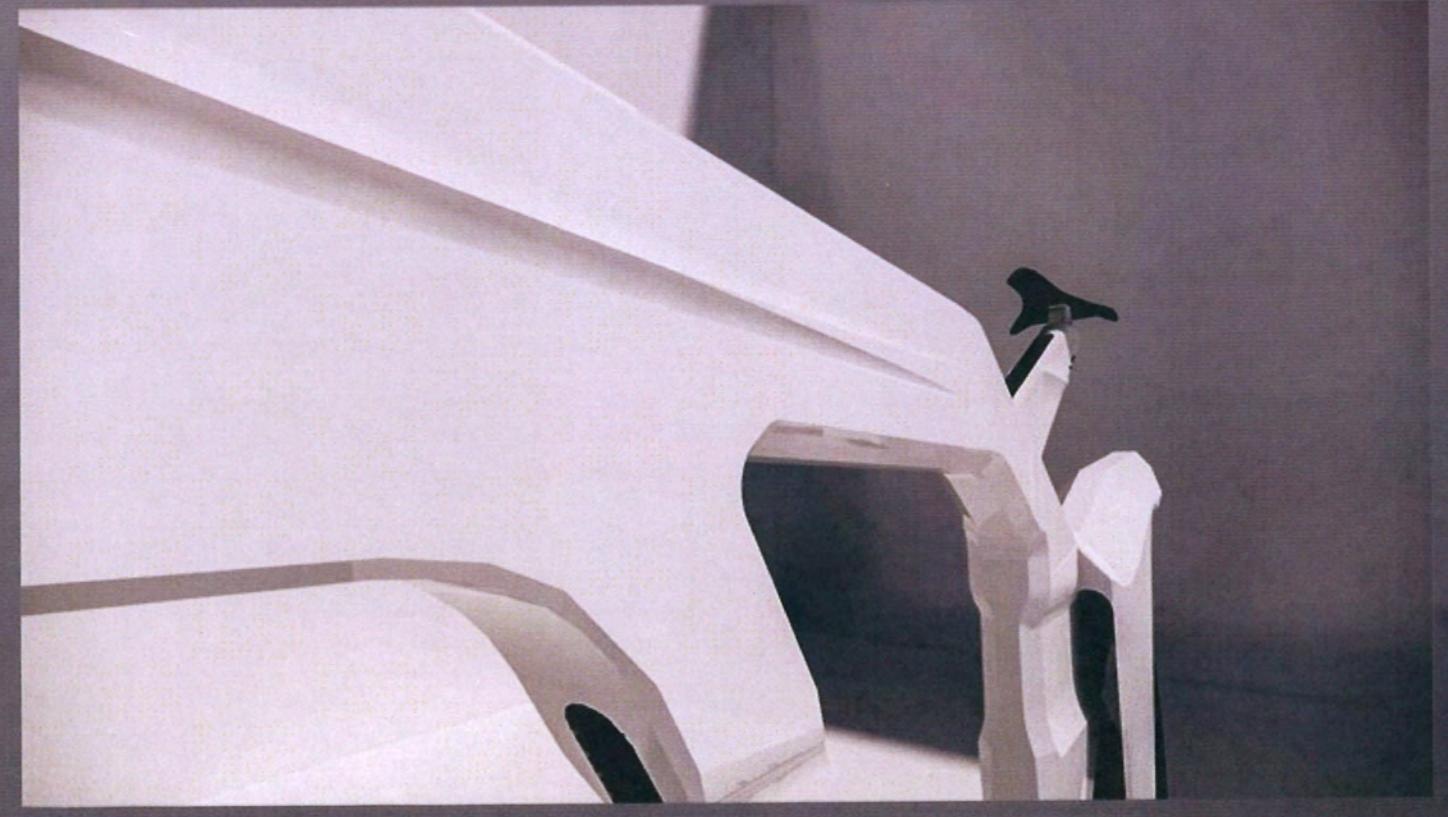
C





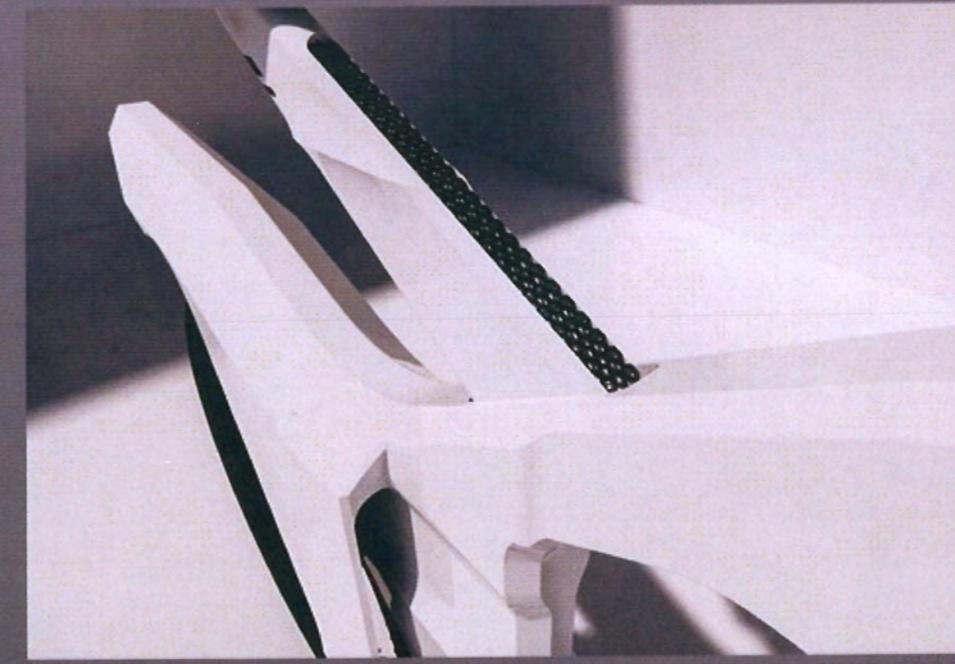
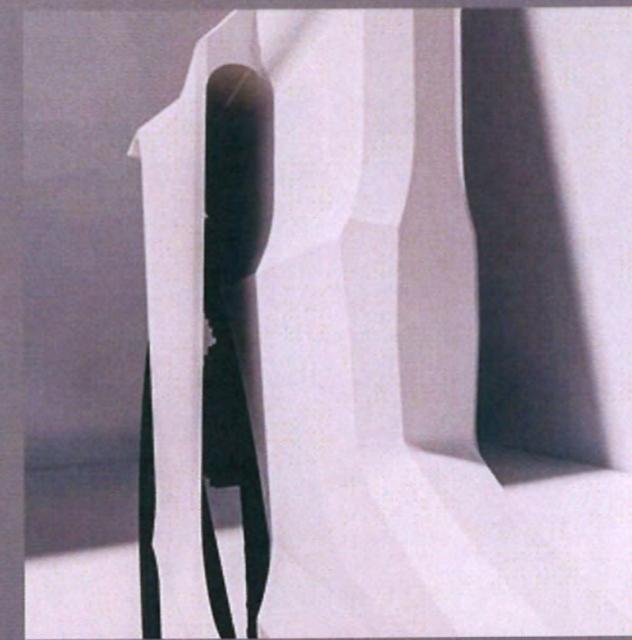
Elegant Styling

Efficient Aerodynamic Forms





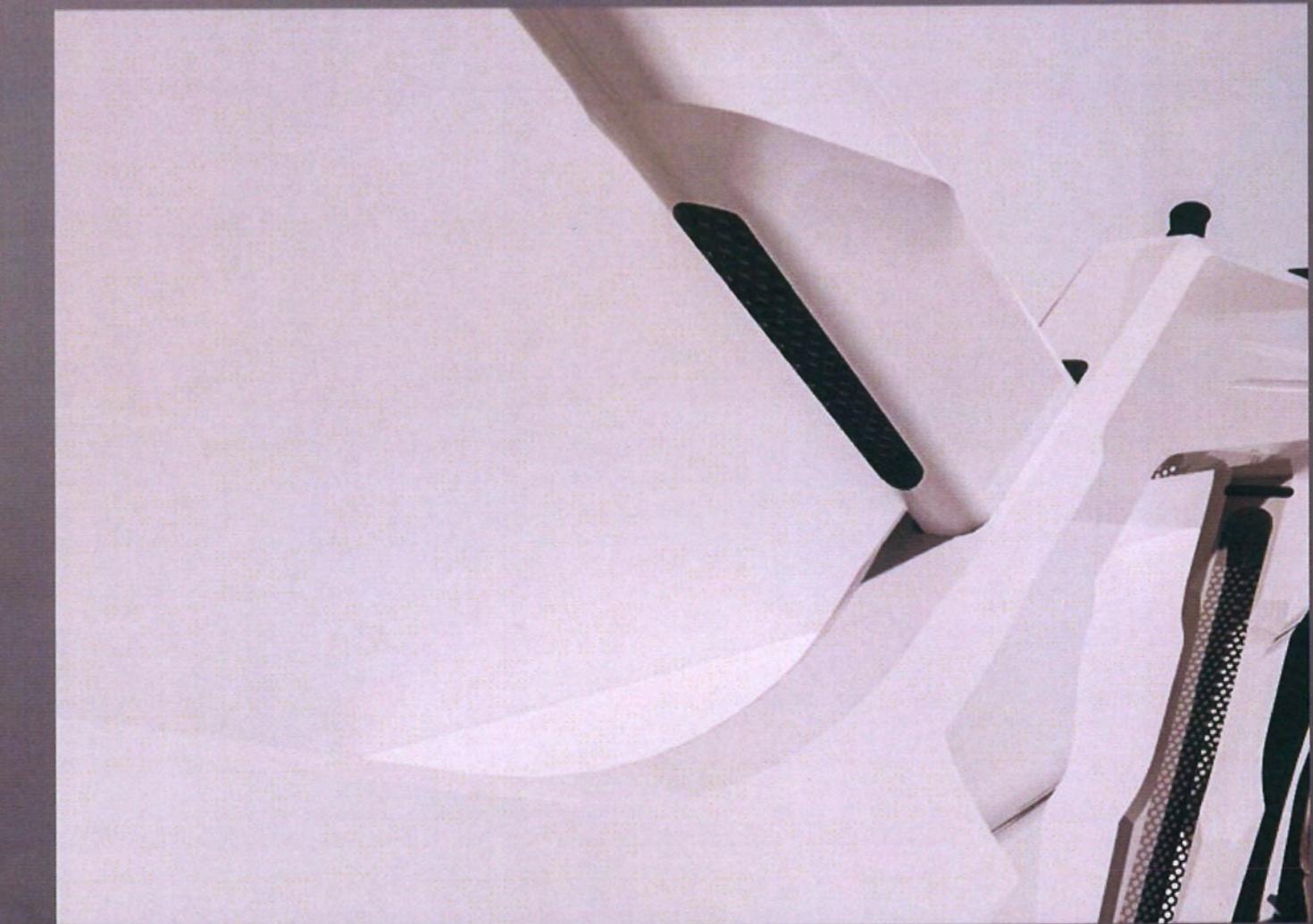
Smooth & dynamic surface
Minimalize Air-Resistance act on the bike





Chamfer edges-
Slims the bike frame

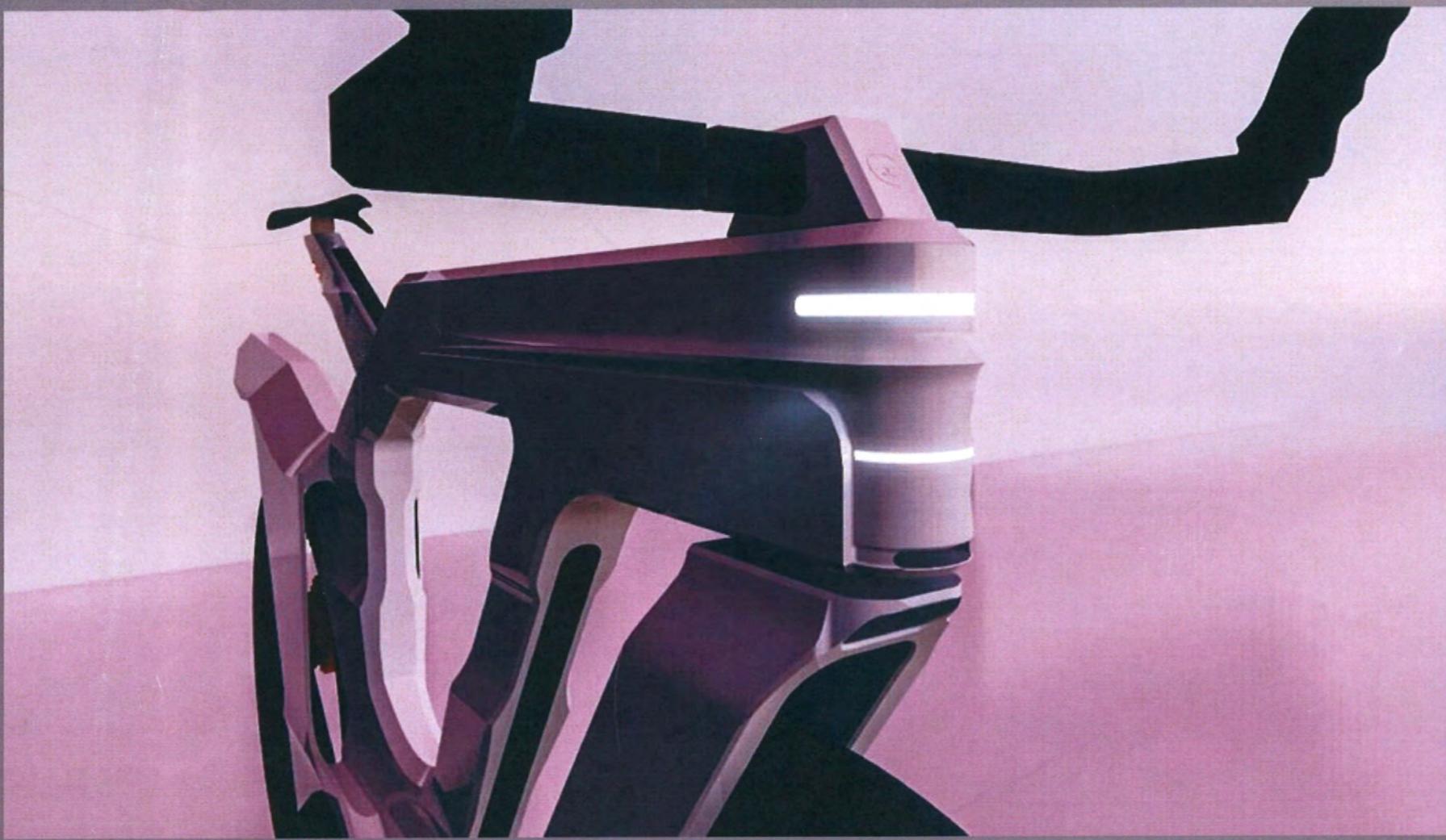
Hollow seat post





Bionic Front Fork Design-
Inspired from the motion of leopard leg landing





Light the way

Brighten the darkness

