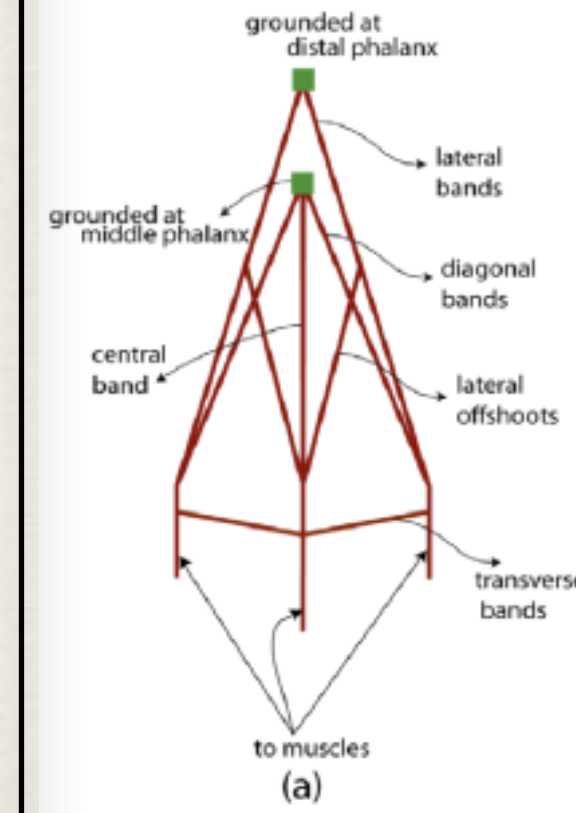
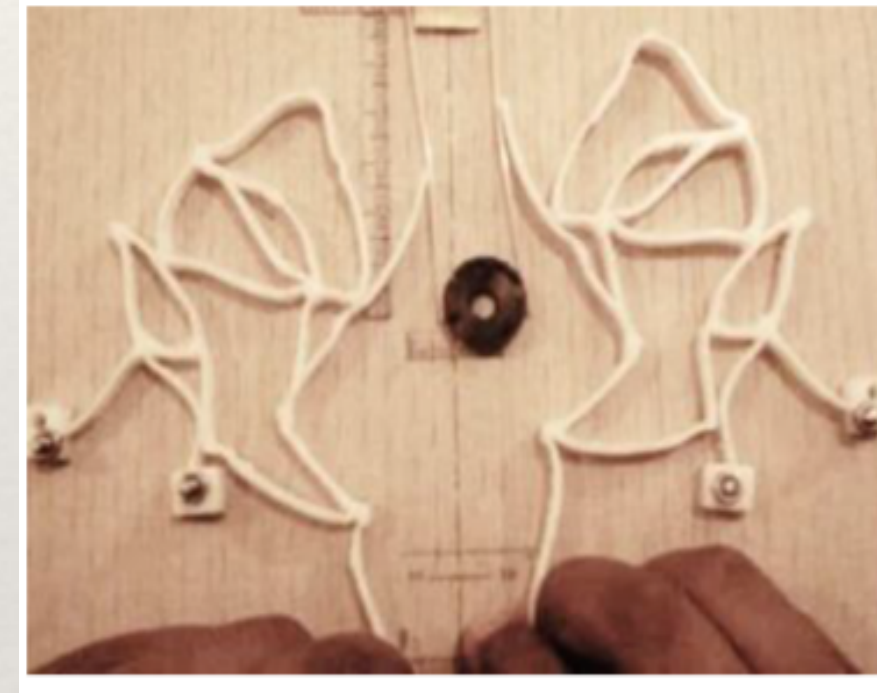
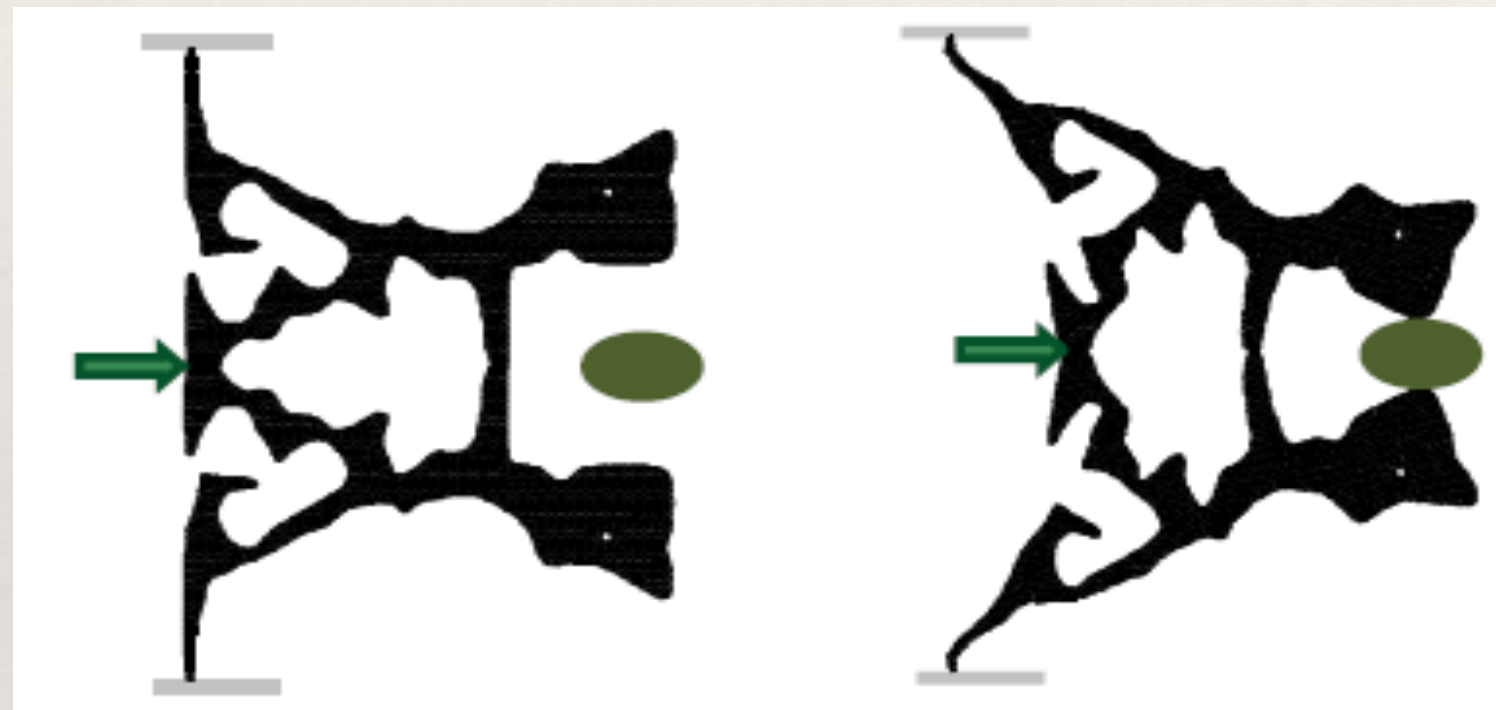
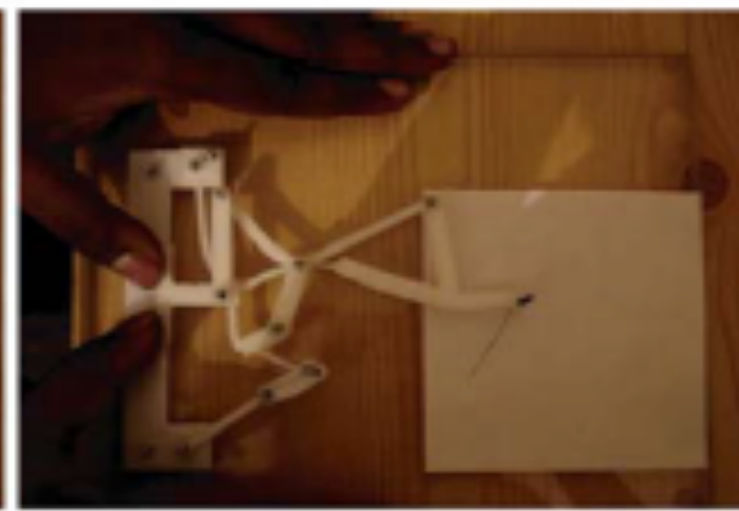
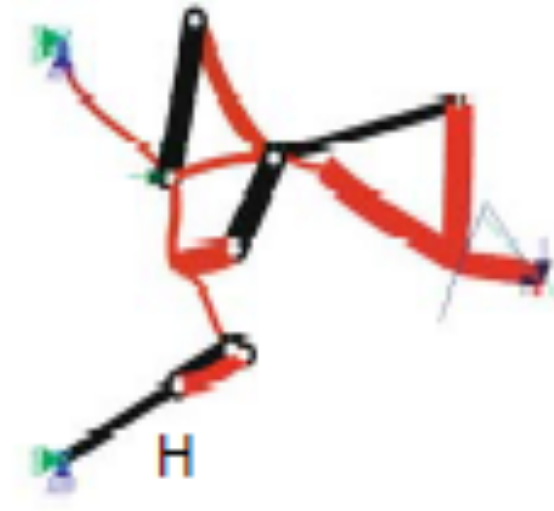
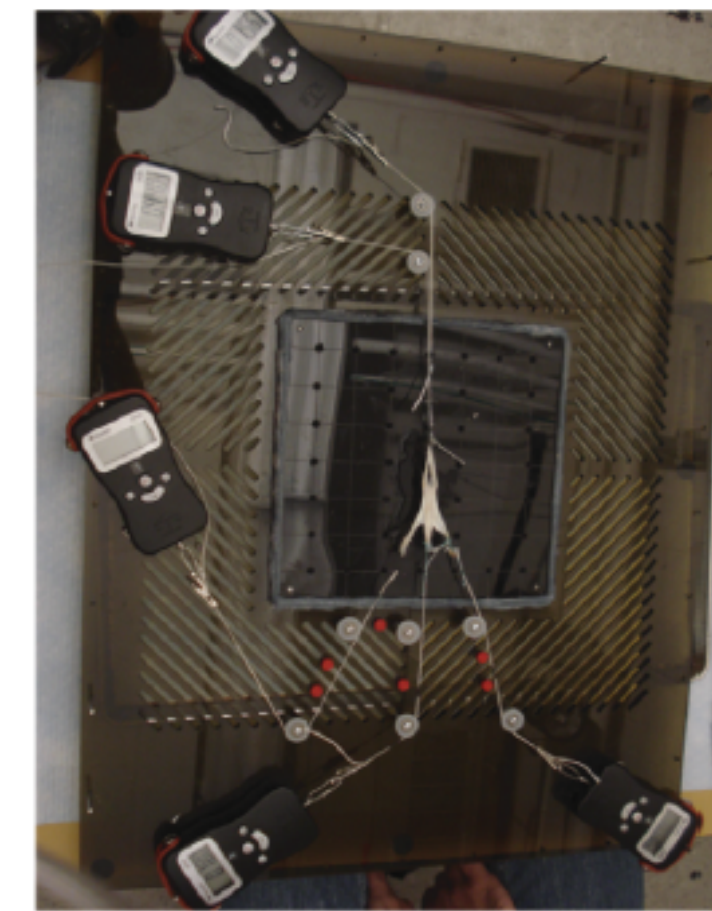
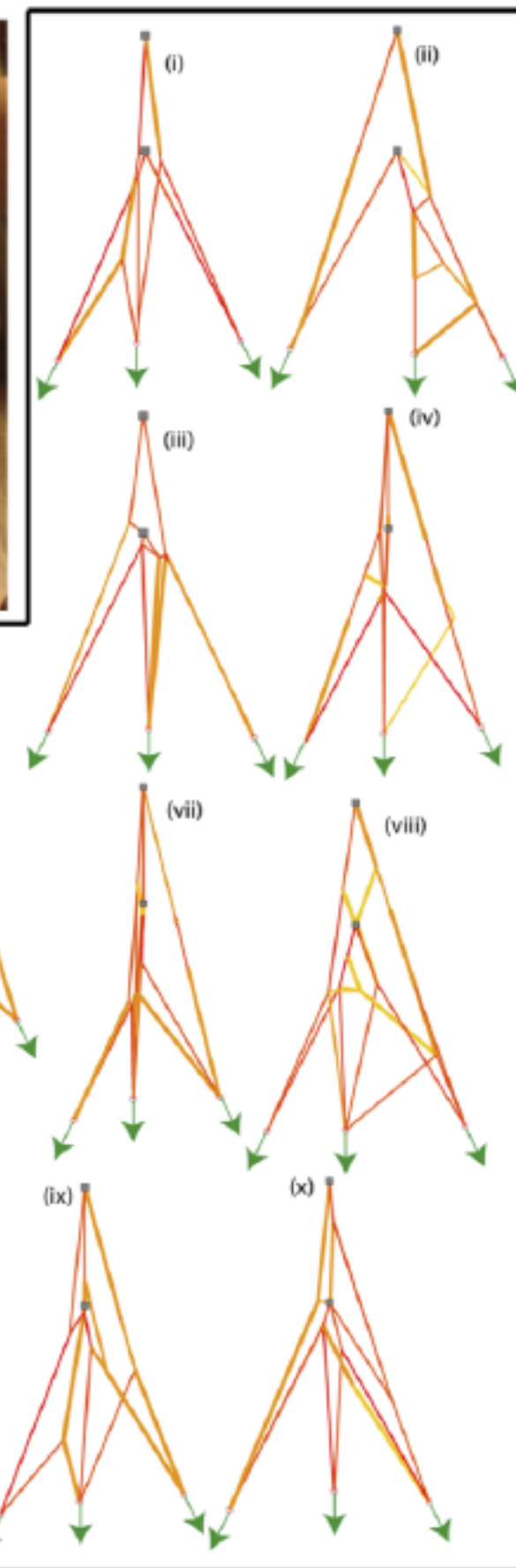




(a)



(b)



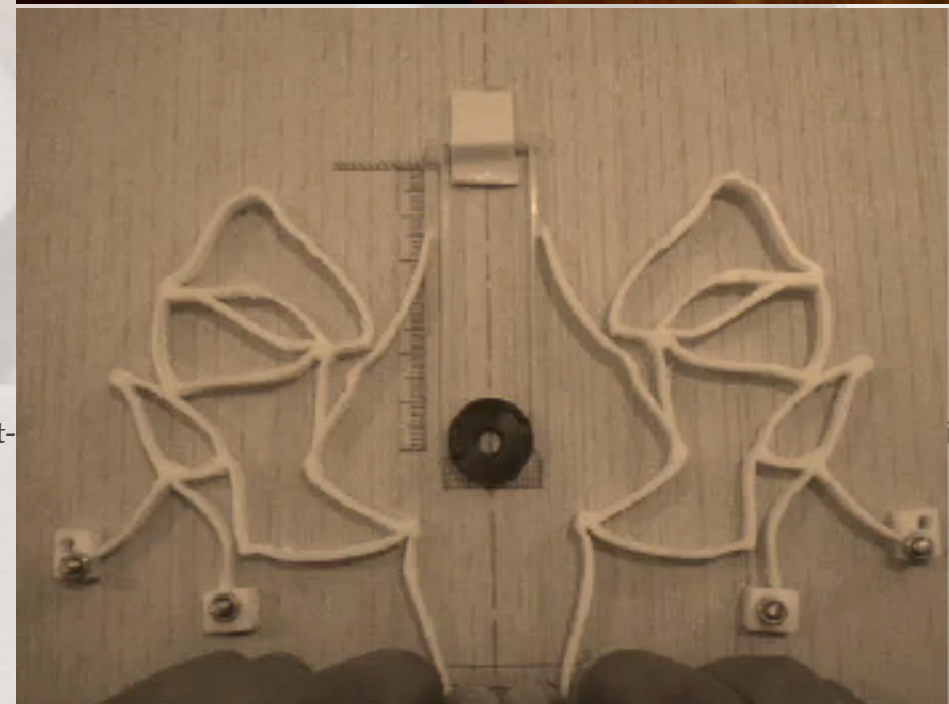
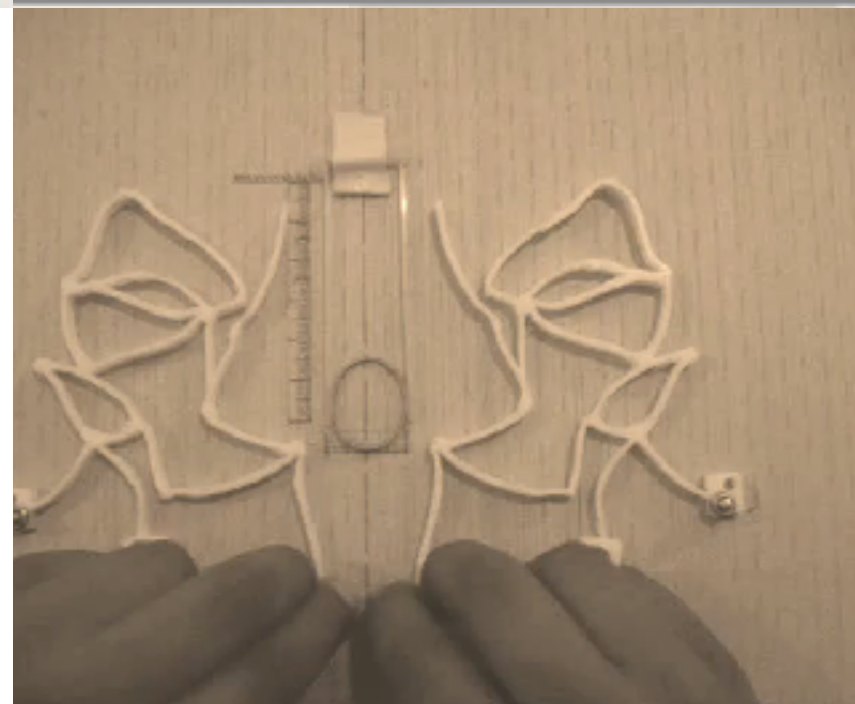
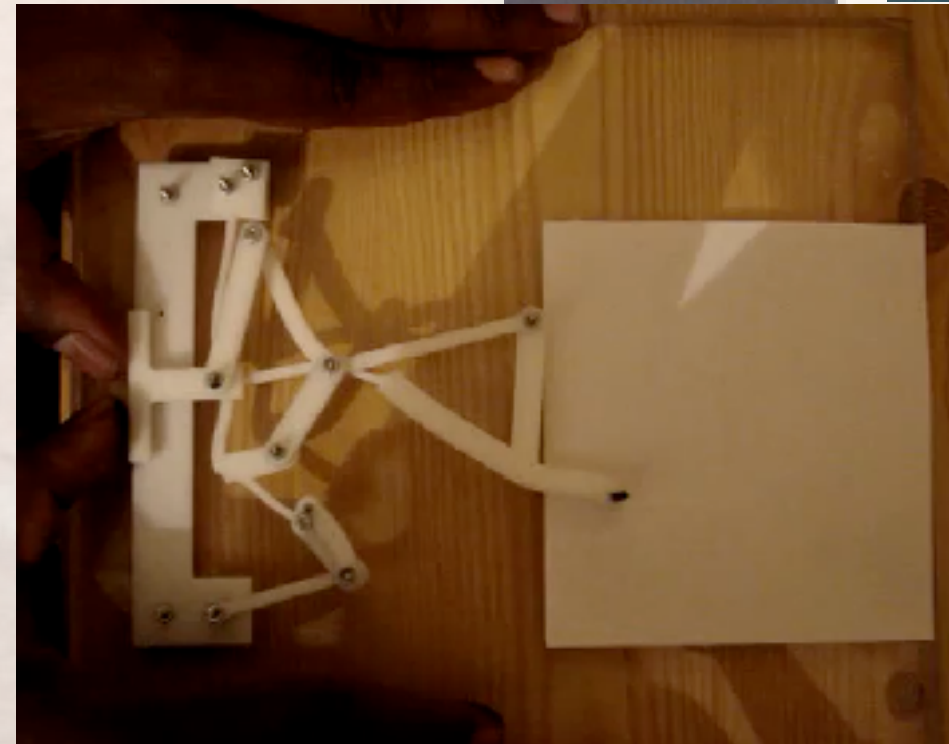
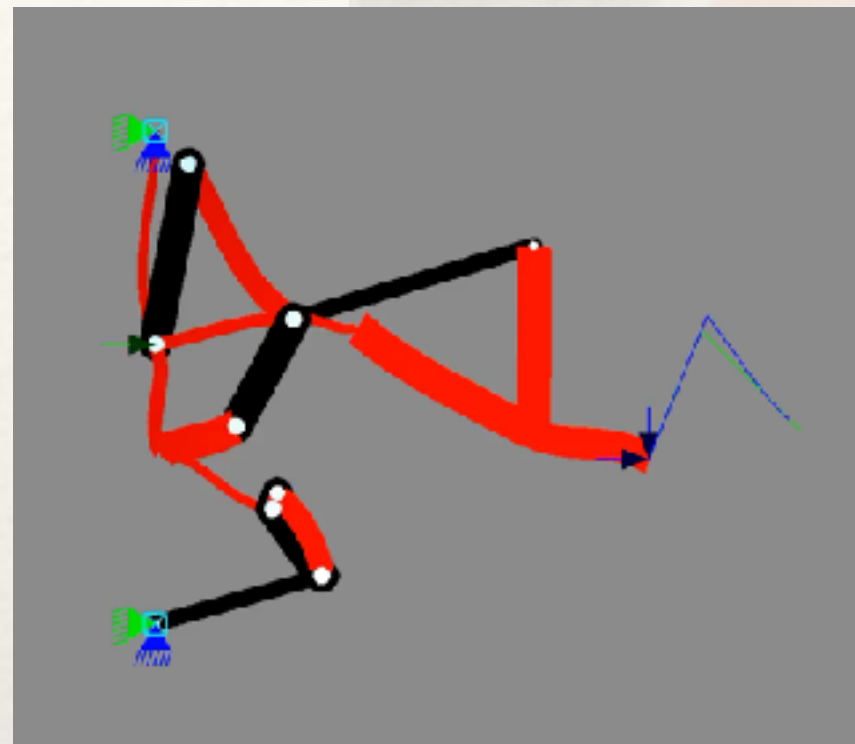
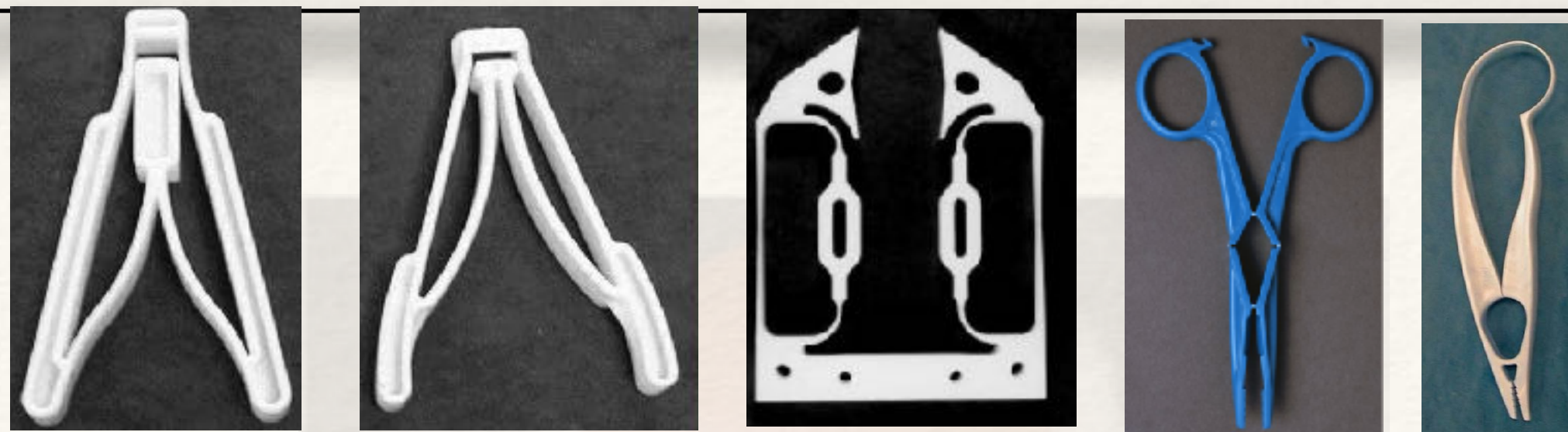
(c)



(d)

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ons/amidha.PNG

Midha

FULLY COMPLIANT MECHANISMS

No rigid-body joints

ALL Members undergo elastic deformation

PARTIALLY COMPLIANT MECHANISMS

SOME rigid-body joints

SOME Members undergo elastic deformation

CONTACT-AIDED COMPLIANT MECHANISMS

No rigid-body joints

ALL Members undergo elastic deformation

Pseudo joints at contact sites

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HOW DO WE CONCEIVE (DESIGN) COMPLIANT MECHANISMS

Intuition / Experience
based

Building Block
Approach

FACT
(Freedom And
Constraint Topologies)

Specific Synthesis
Approaches

Rigid-body replacement
(PRBM)

(Large Deformation)
Structural Optimization

Prof. Ashok Midha

Function and Advantages

Force, Motion and/or Energy Transfer
Function, Path and Motion Generation
Repeatability

Disadvantages (Would we now witness)

~~Friction~~

~~Wear and Tear~~

~~Lubrication~~

~~Vibrations~~

~~Noise~~

~~Need for Assembly~~

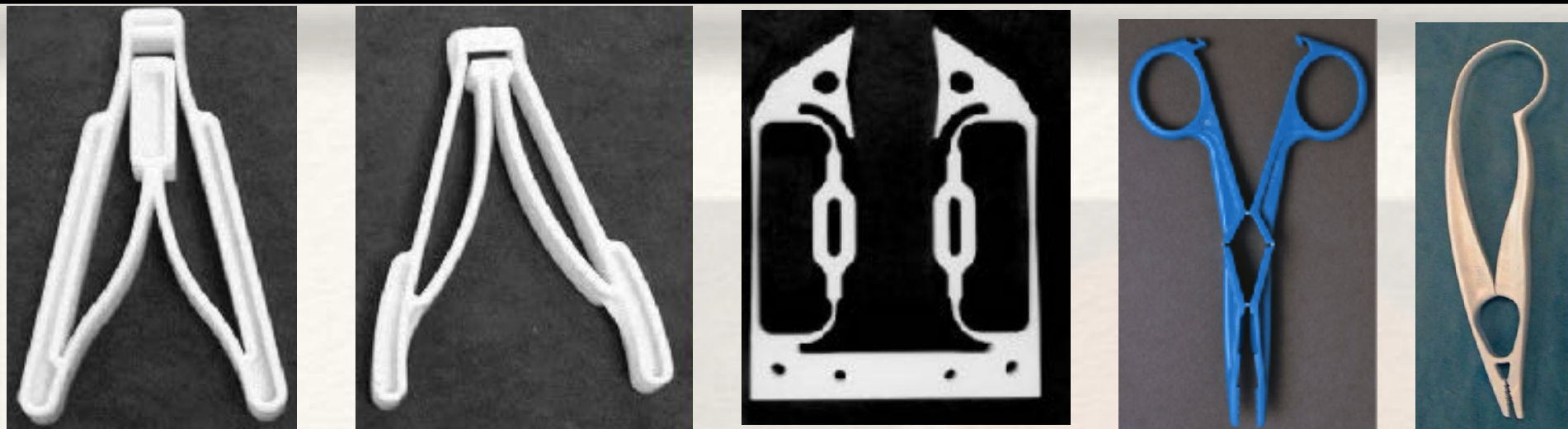
~~Backlash (play)~~

Great Deal of Web material

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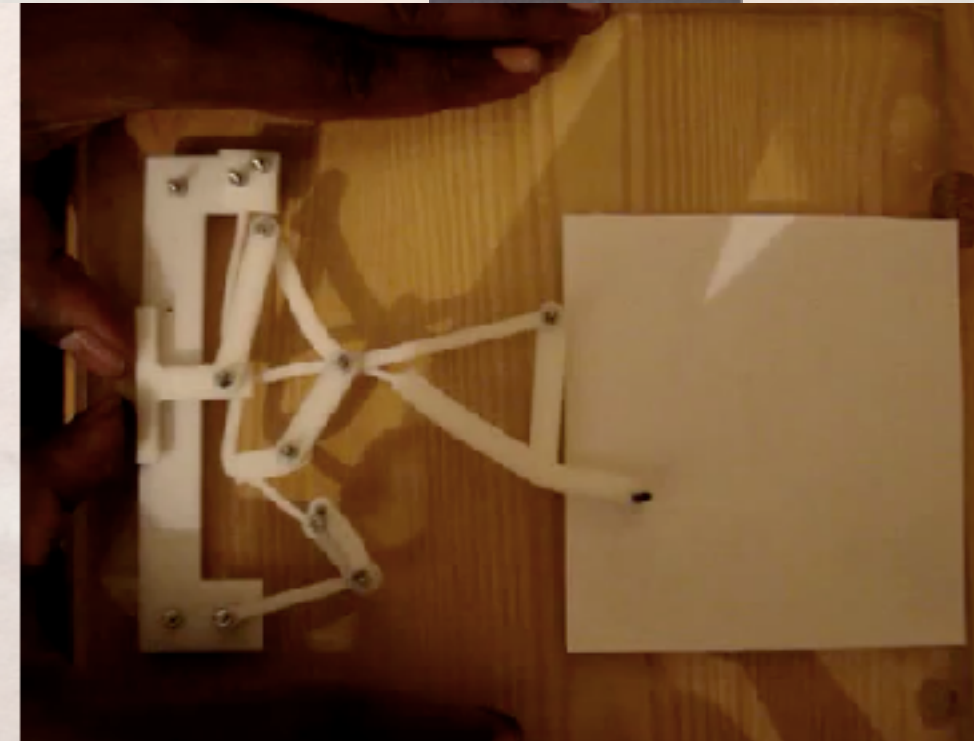
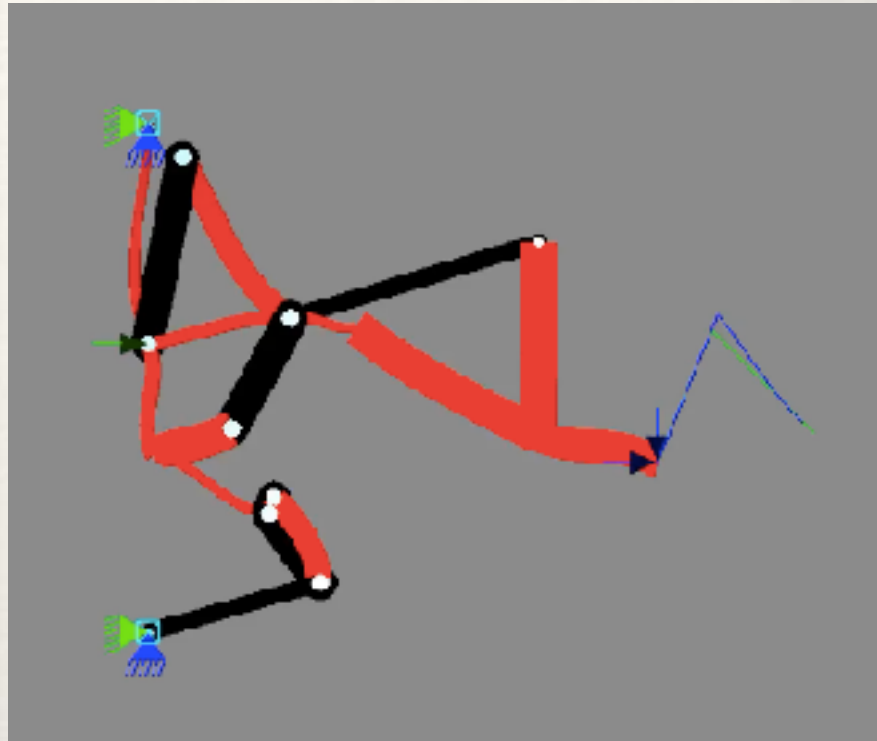
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**COMPLIANT MECHS.
CAN BE DESIGNED
FOR INFINITE LIFE**

Ensure Low Stresses



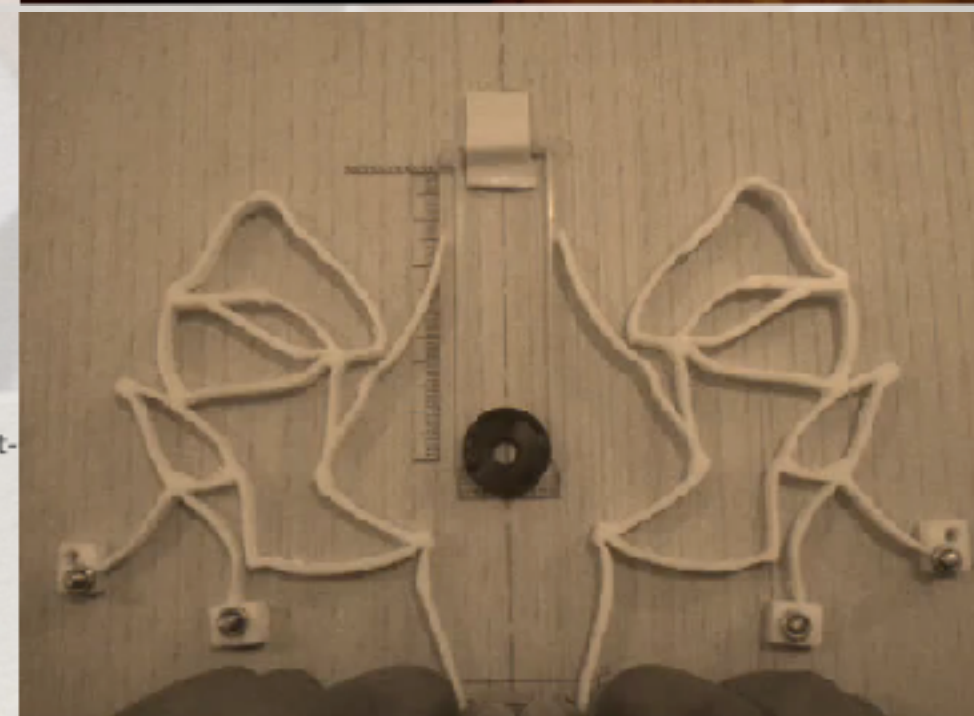
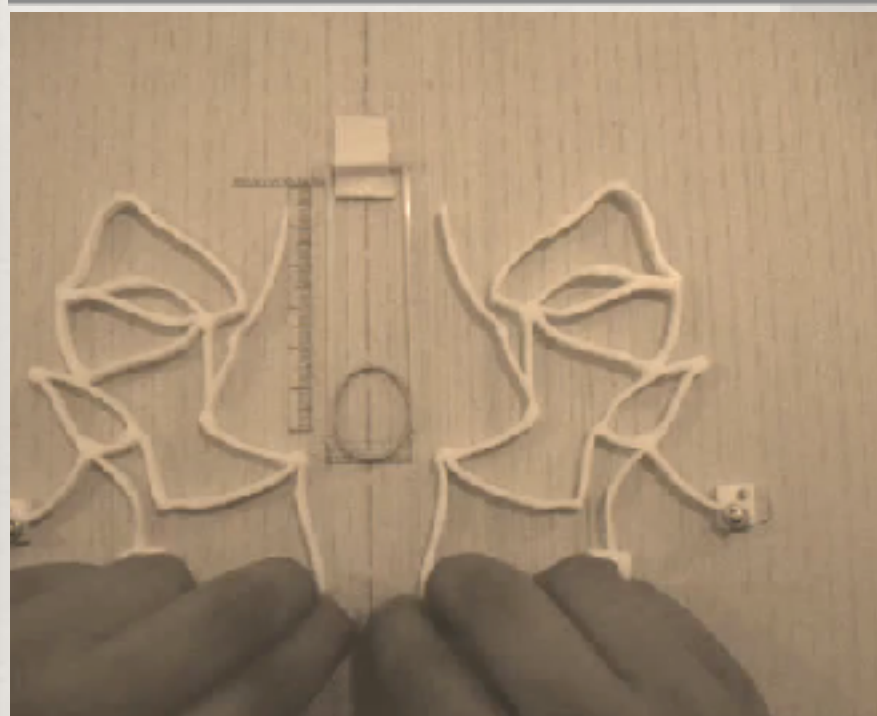
DESIGN ASPECTS

ANATOMY

- Topology
- Shape
- Size

MATERIAL

- Elastic modulus
- Poisson's ratio



APPLICATIONS ...

Aerospace/Automotive

Sensing, Actuation, Grasp, Manipulation

Biomedical/Healthcare

Orthotic/Prosthetic devices

Robotics

Soft/Medical

Miniature Scales

Micro/Nano Electro Mechanical Systems

Space

Foldable/Deployable mechanisms

Product Design

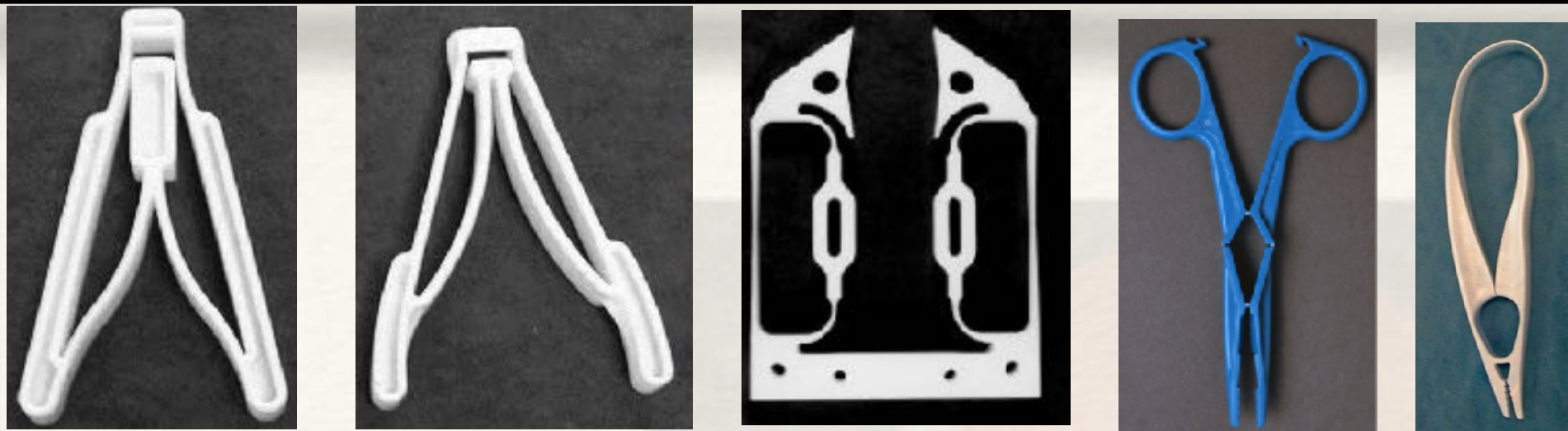
Special Purpose Mechanisms

- Statically balanced mechanisms
- Bistability
- Constant I/O force mechanisms

Compliant Mechanisms (ME 851)

**Anupam Saxena
Professor**

Indian Institute of Technology Kanpur



MATERIAL ?

Proof of Concept EGs.

ADDITIVE MANUFACTURING

ABS

(Acrylonitrile butadiene styrene)

Thermoplastic (recyclable)

Petroleum

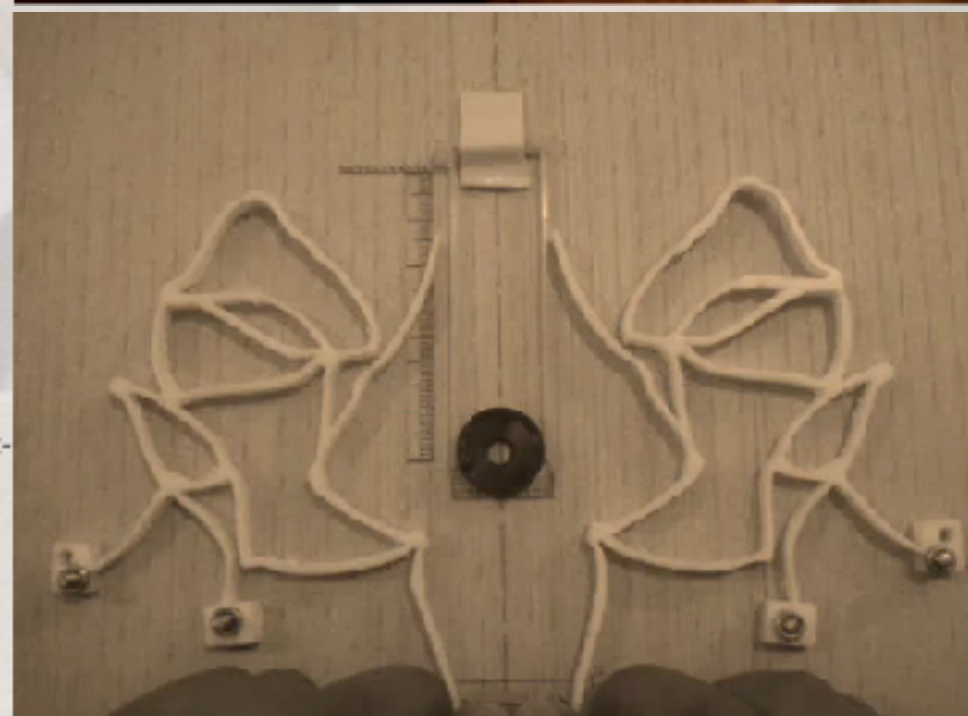
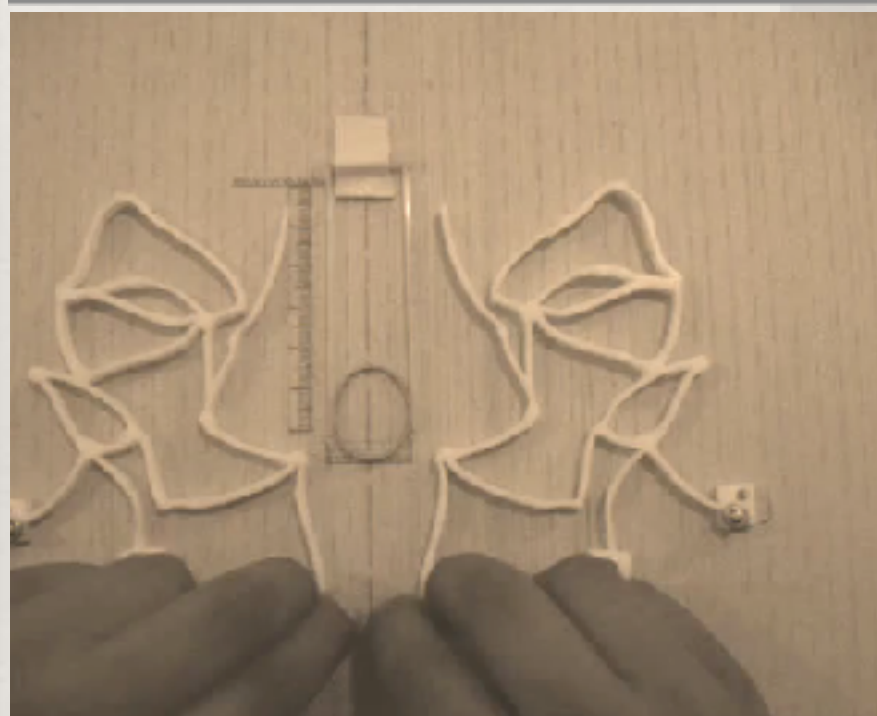
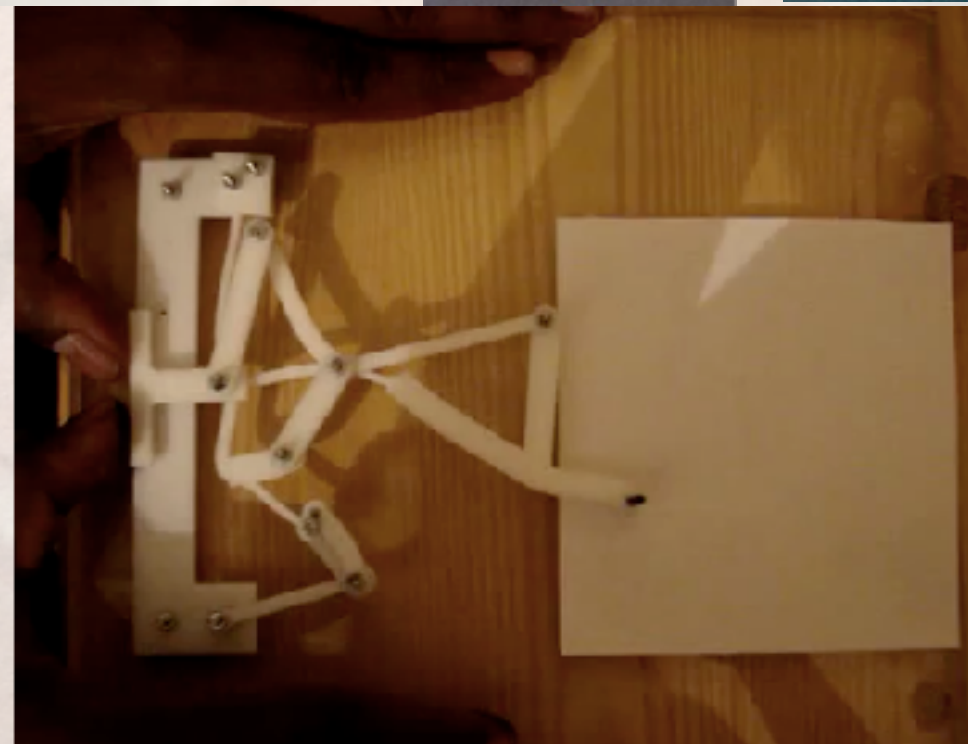
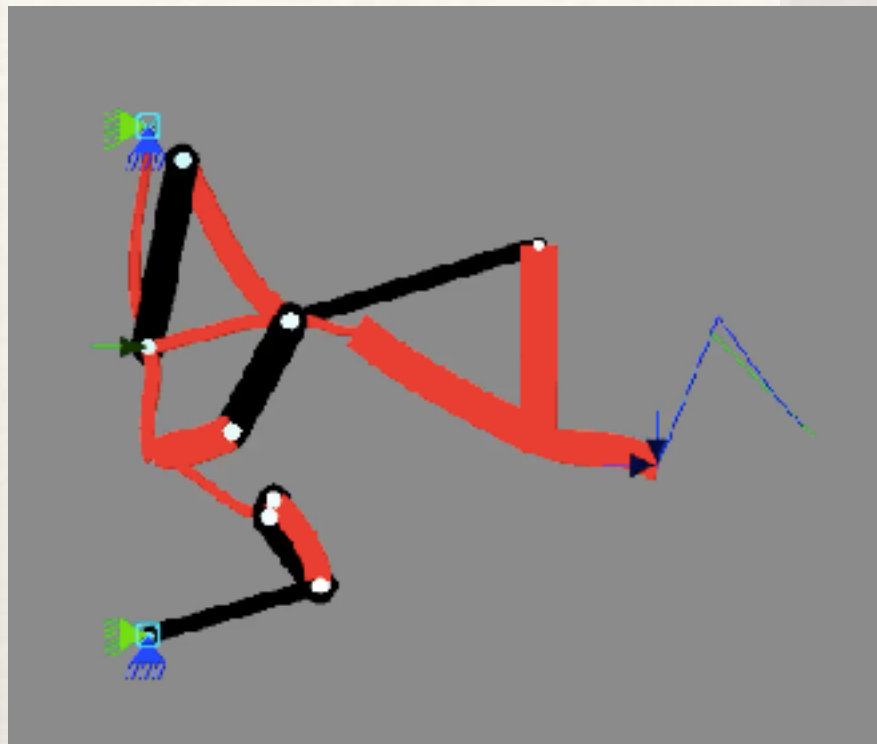
6000 grades available

Non-biodegradable (500 y)

Polycarbonate

recyclable

Some non-biodegradable



APPLICATIONS ...

Aerospace/Automotive

Sensing, Actuation, Grasp, Manipulation

Biomedical/Healthcare

Orthotic / Prosthetic devices

Robotics

Soft / Medical

Miniature Scales

Micro / Nano Electro Mechanical Systems

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Foldable / Deployable mechanisms

Product Design

Special Purpose Mechanisms

Statically balanced mechanisms

Bistability

Constant I/O force mechanisms

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15th September, 2000

Prof. Ashok Mishra

Better Designer

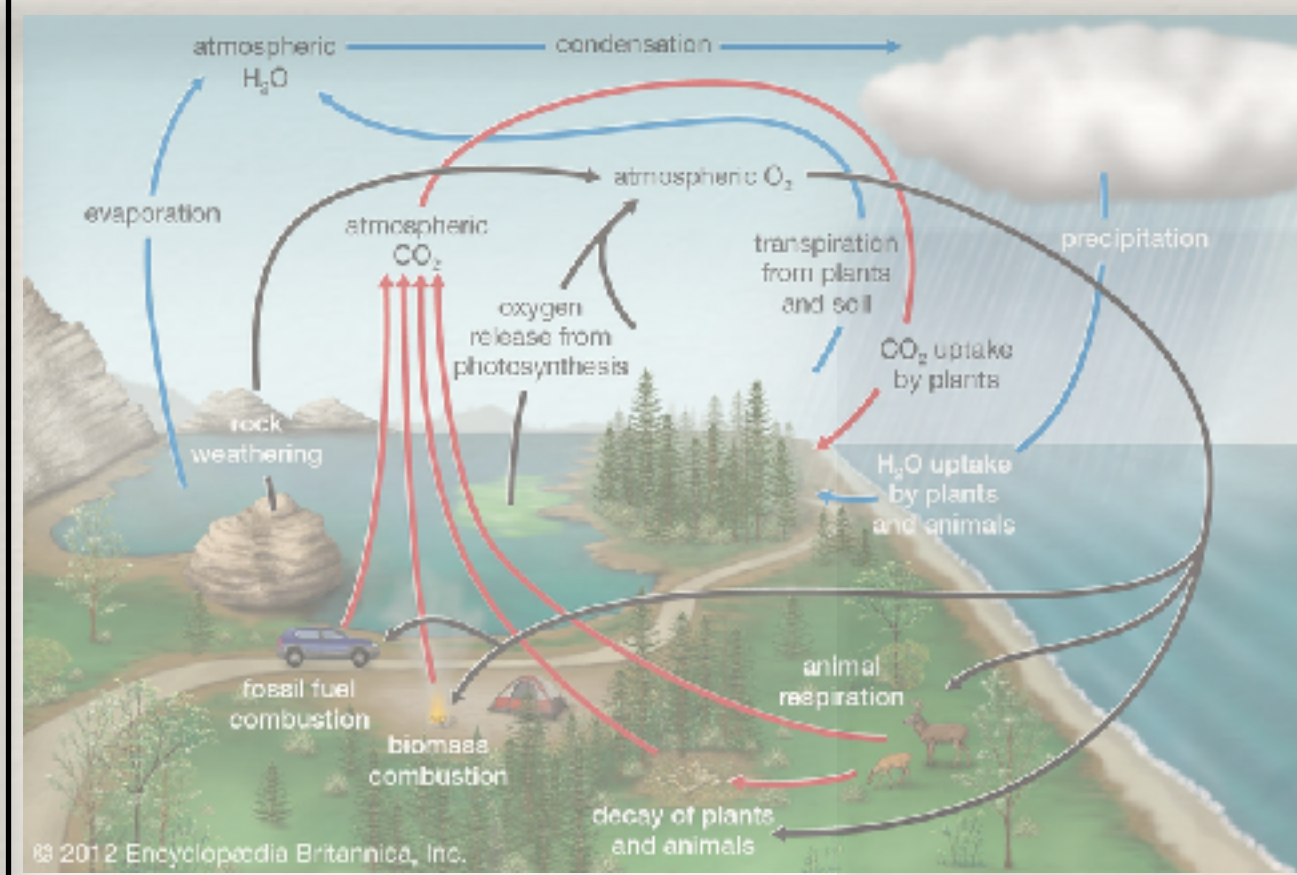
Man or Nature



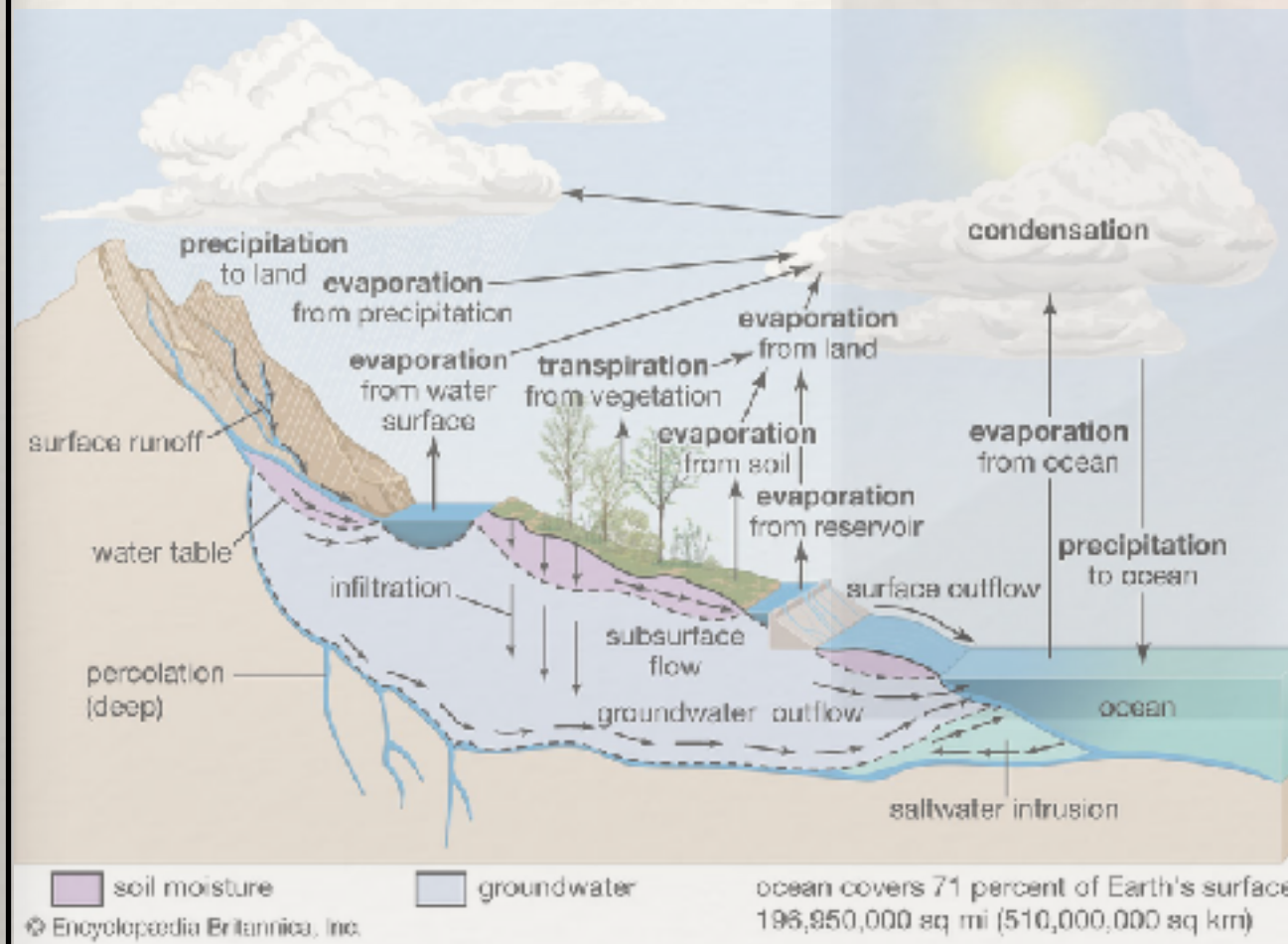
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Professor

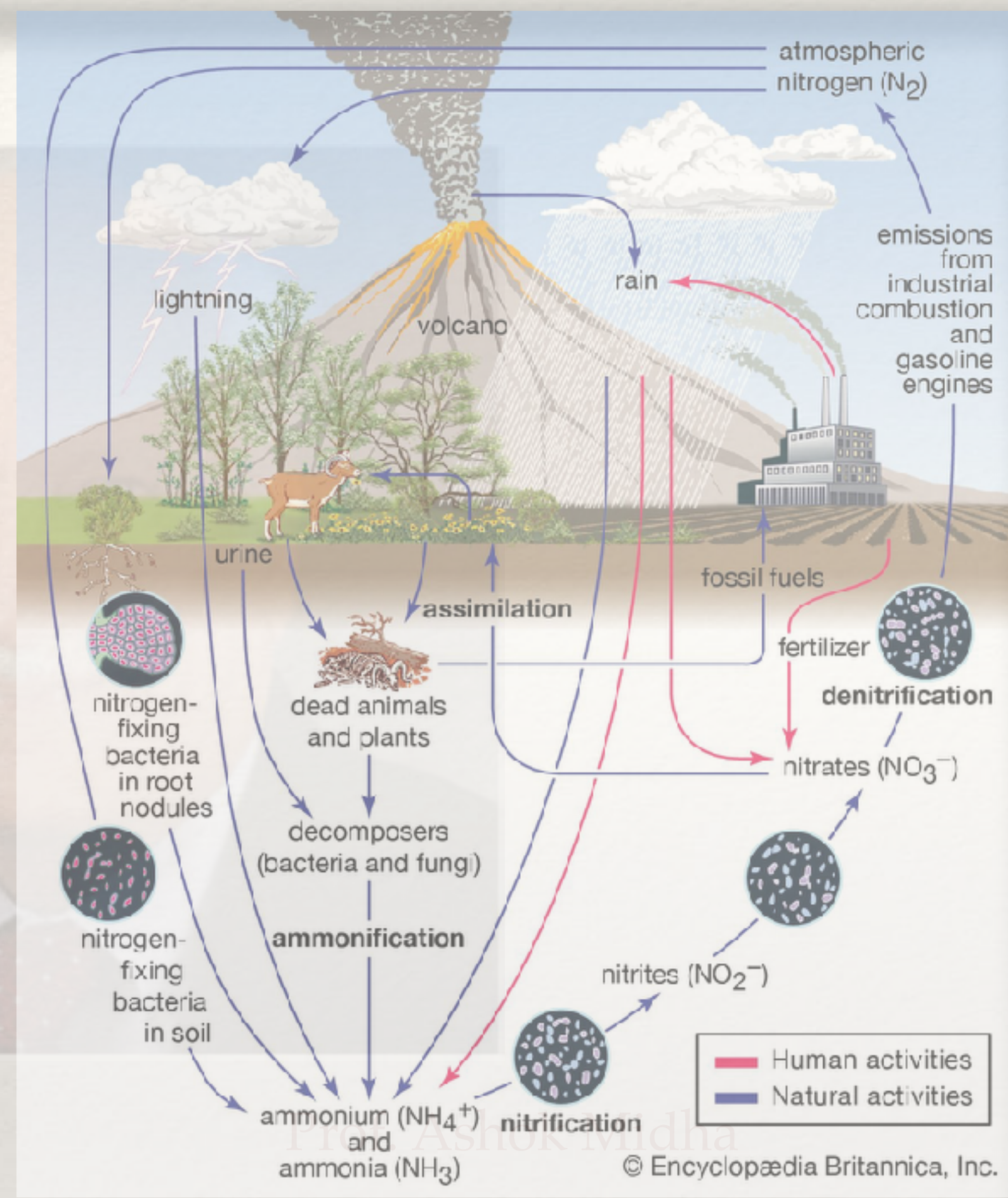
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<https://www.britannica.com/science/oxygen-cycle>

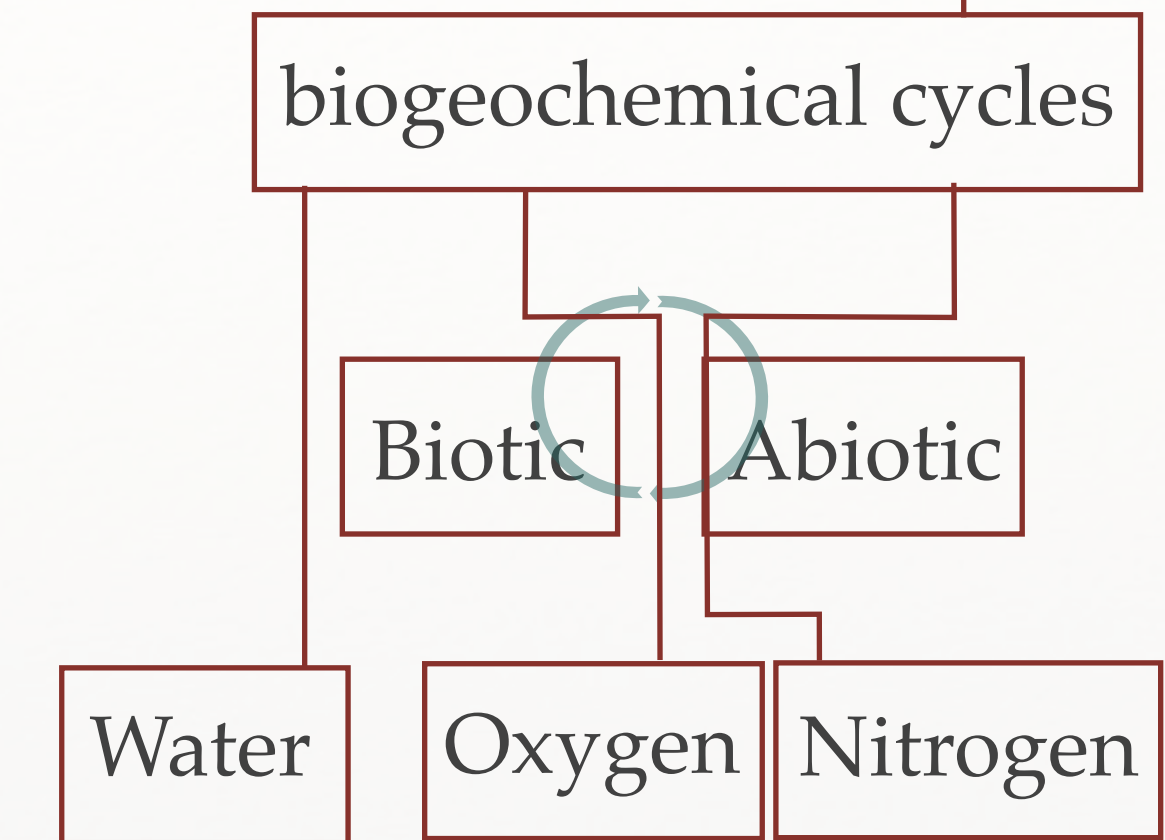


ocean covers 71 percent of Earth's surface
 196,950,000 sq mi (510,000,000 sq km)
 © Encyclopædia Britannica, Inc.
<https://www.britannica.com/science/water-cycle>



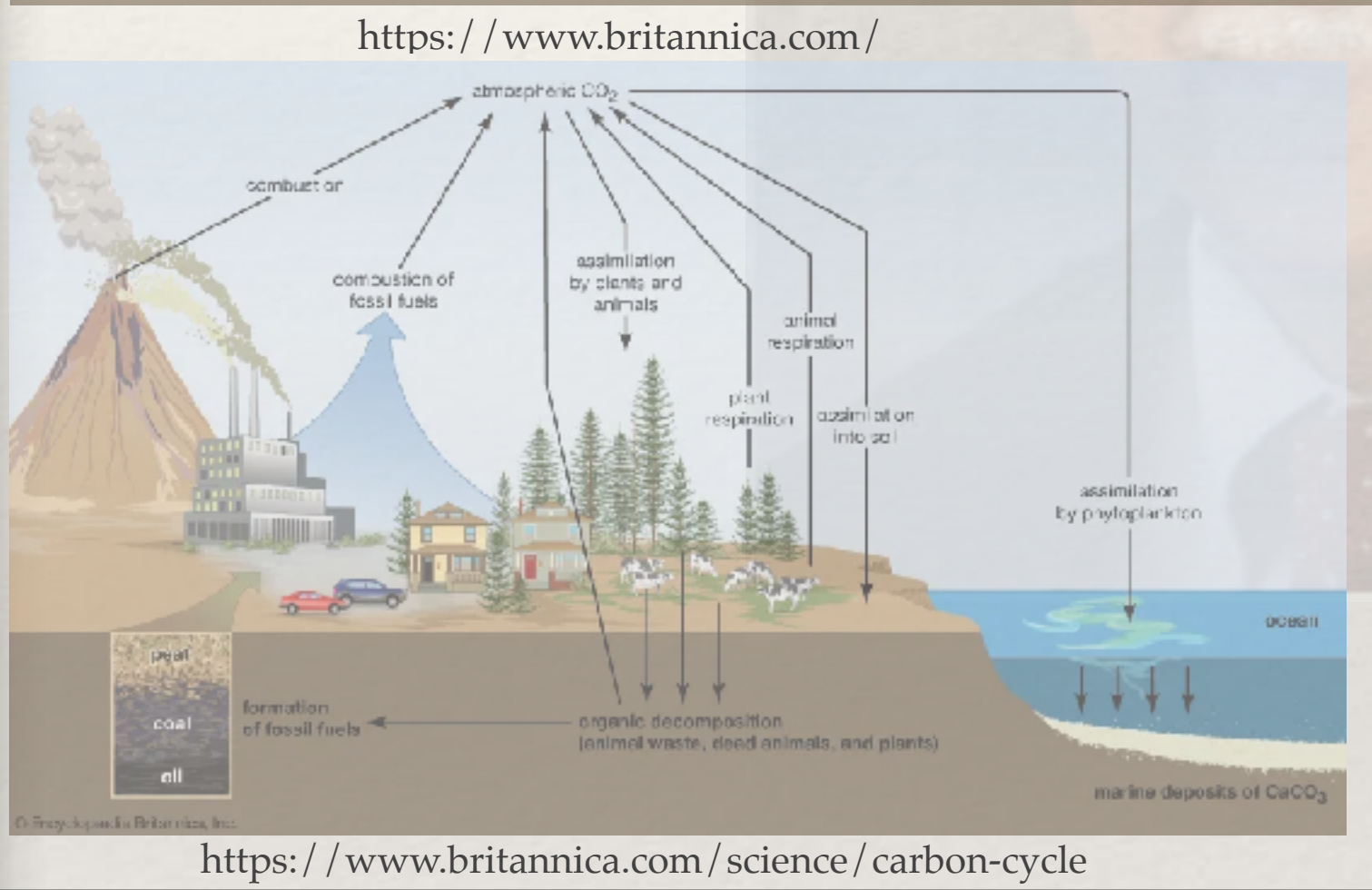
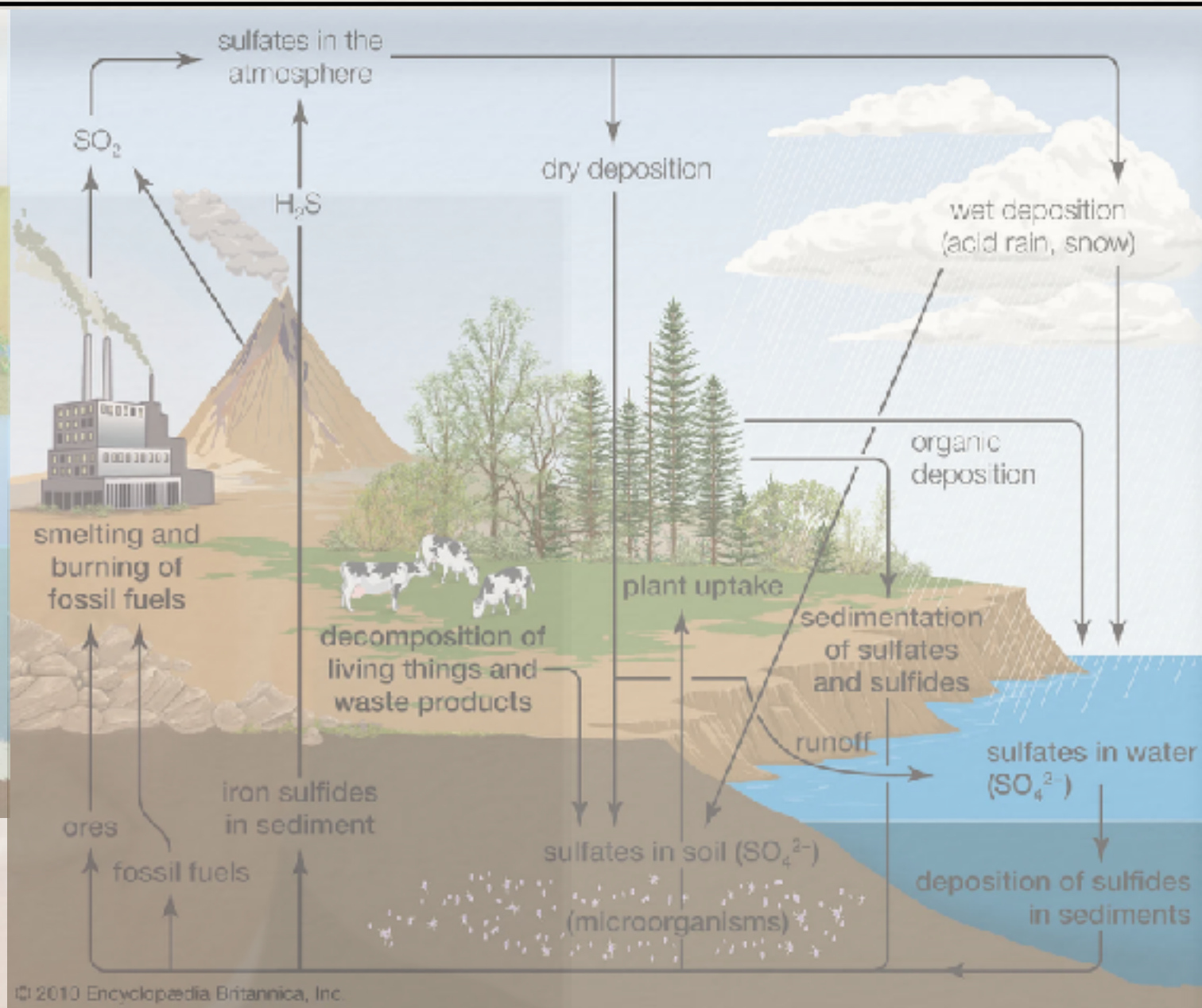
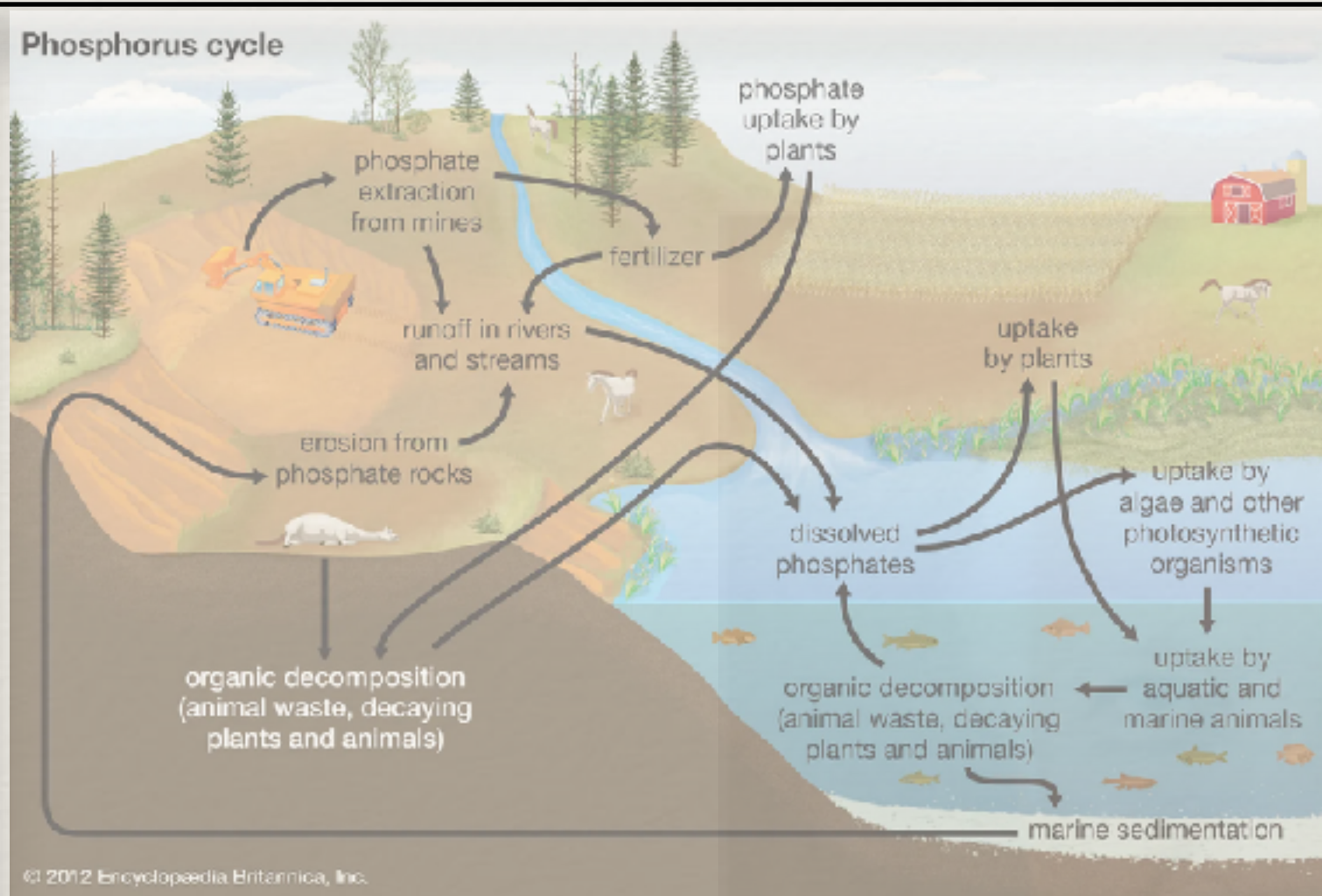
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<https://www.britannica.com/science/nitrogen-cycle>

Better Designer Man or Nature



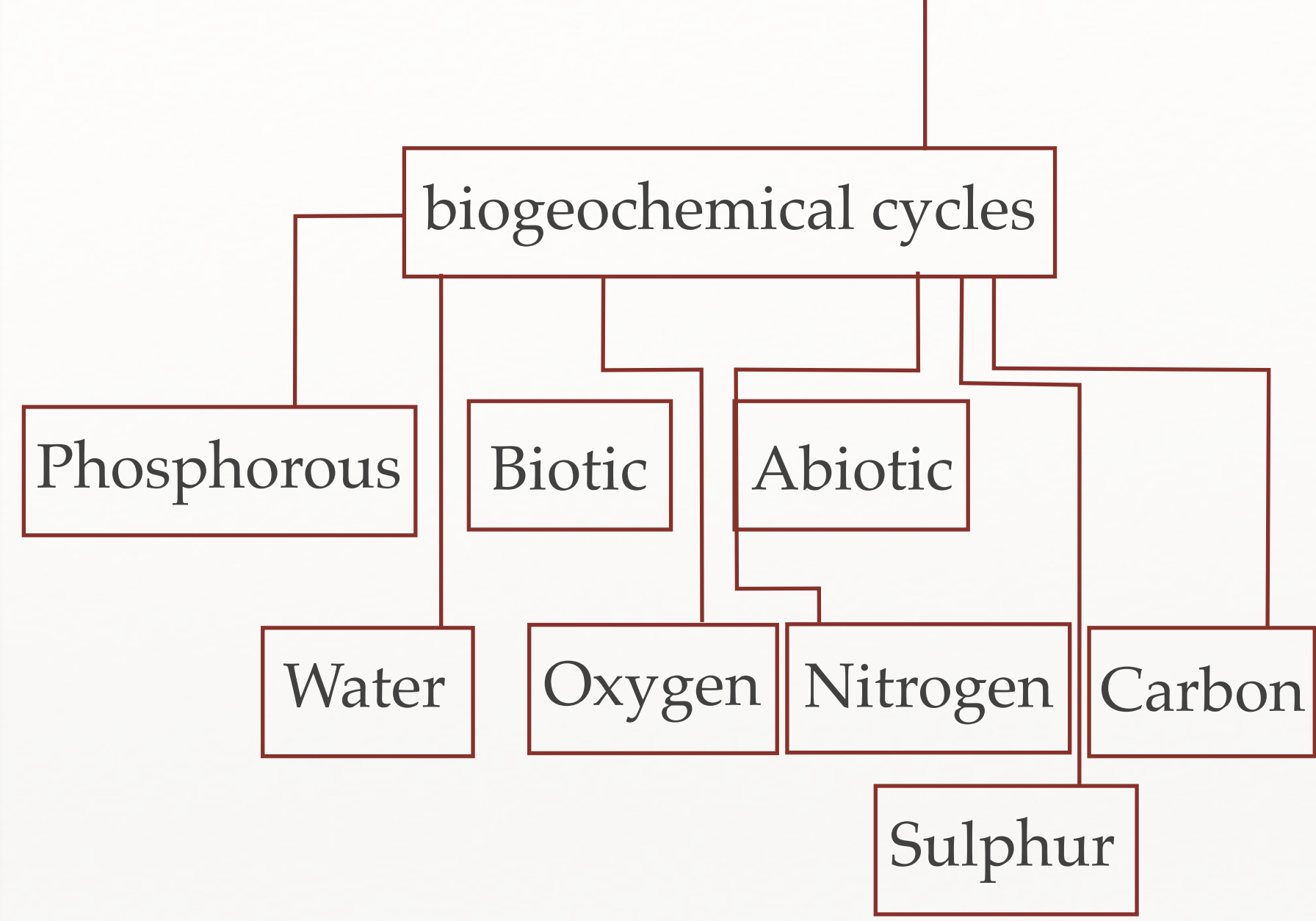
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Nature works on
Zero-Waste Principle

Better Designer Man or Nature



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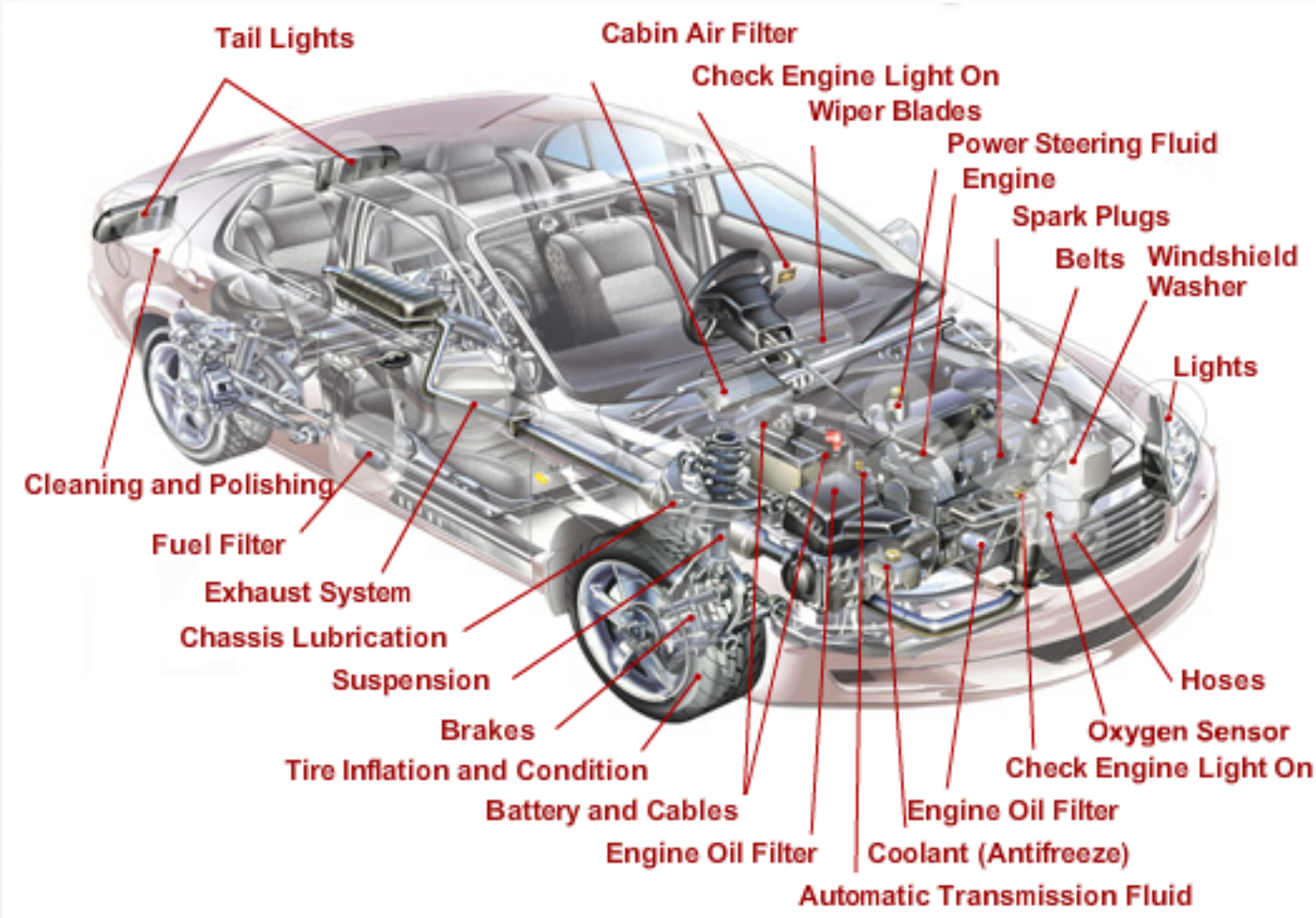
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NEED

O

Human
as a DESIGNER

To travel from a place to another



<https://www.pinterest.de/pin/651685008556791265/>

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NEED

FUNCTION

O

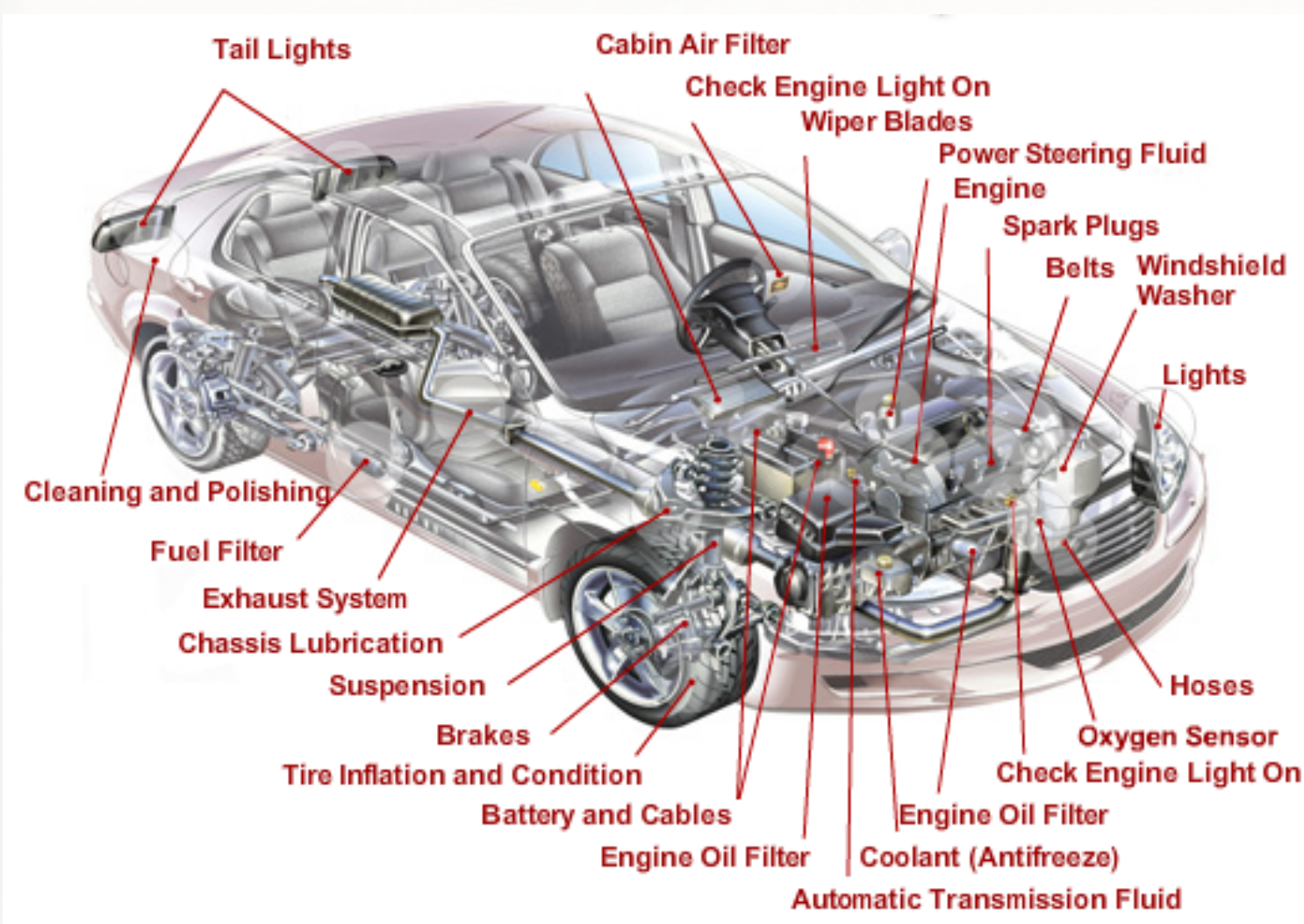
Human
as a DESIGNER

Comfort Speed Safety

Cost Effective Automation Efficiency

Night drive Long distance drive

...



<https://www.pinterest.de/pin/651685008556791265/>

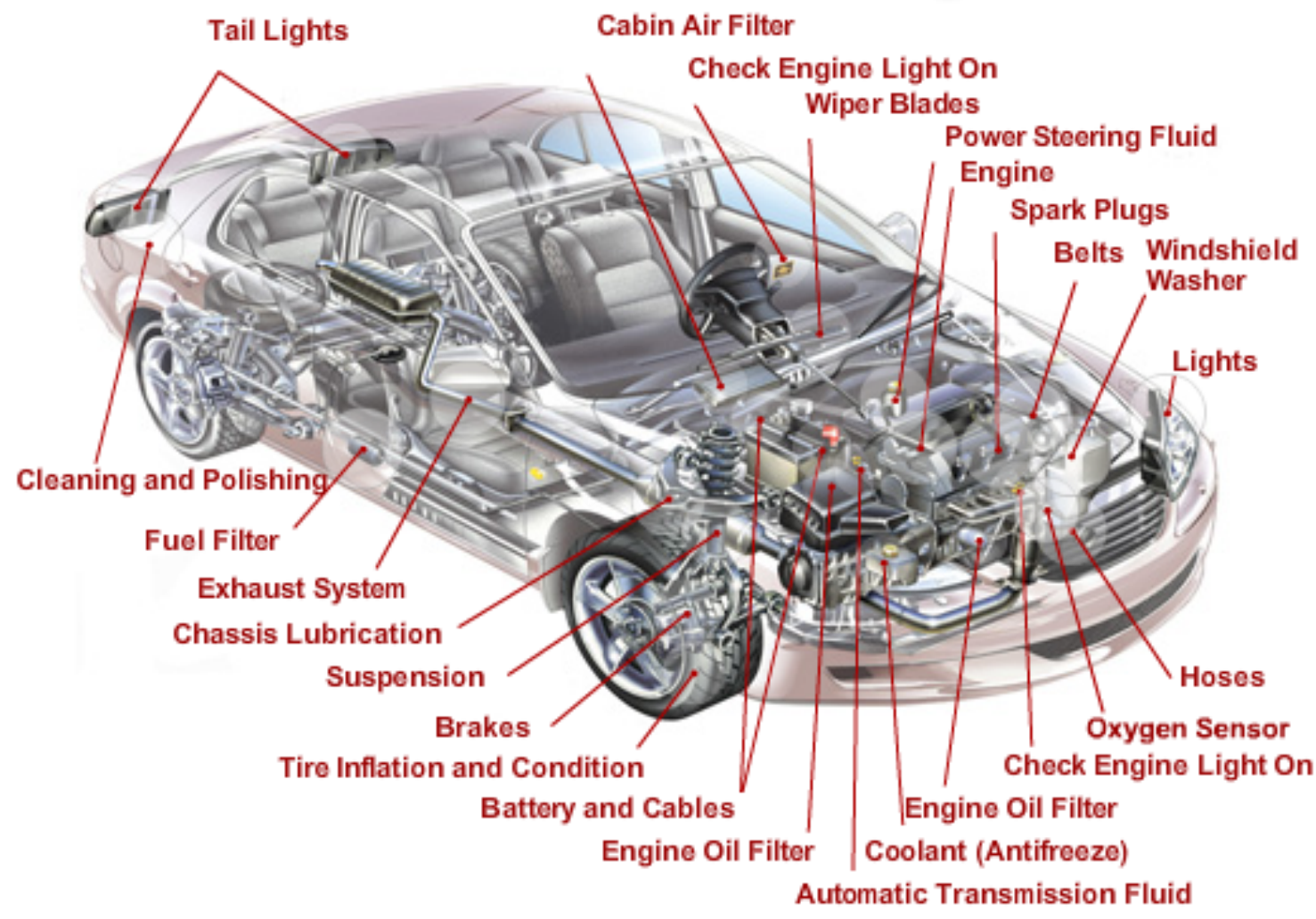
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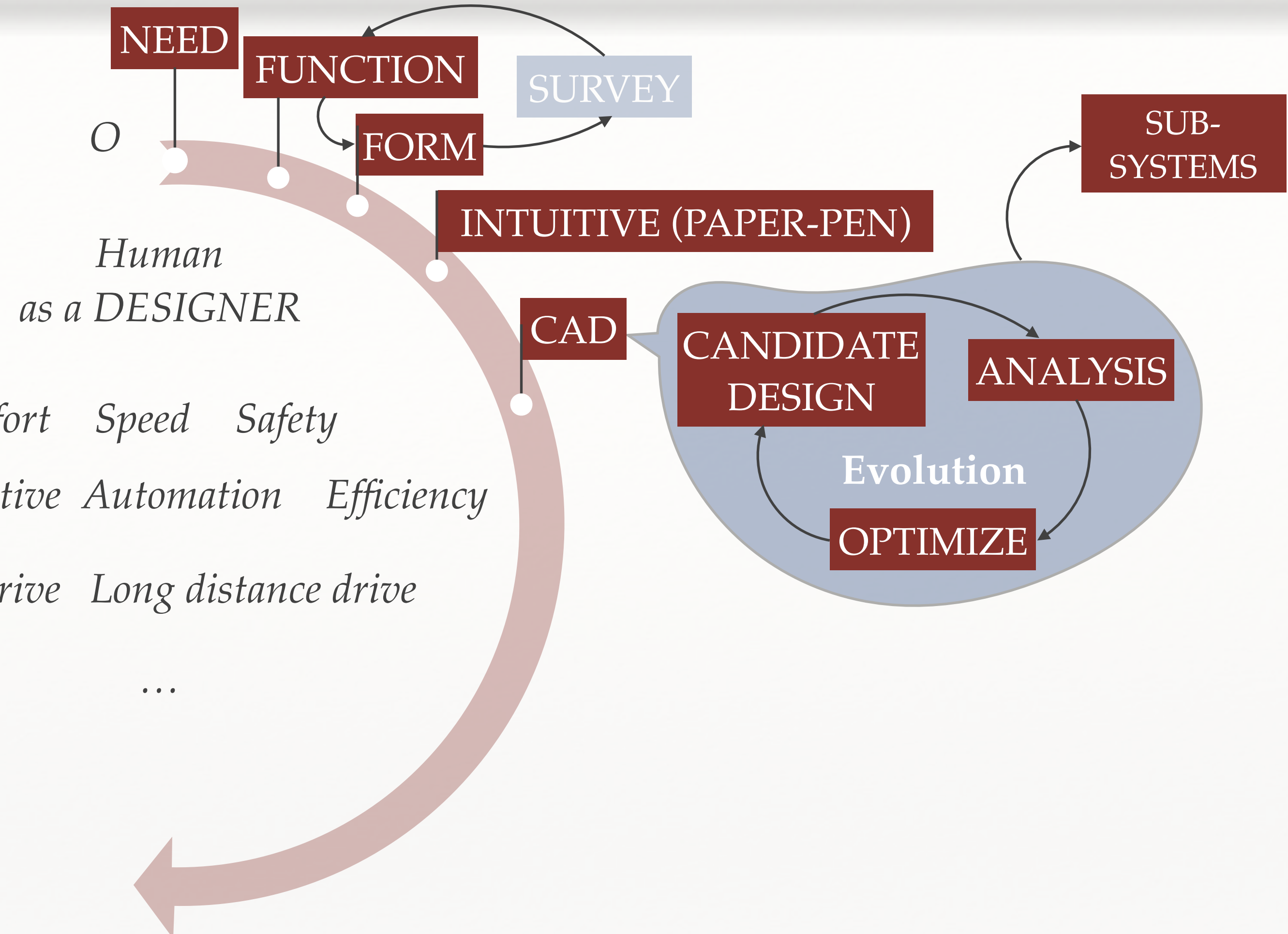
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<https://engineeringlearn.com/top-9-types-of-cars-with-pictures-names-complete-details/>

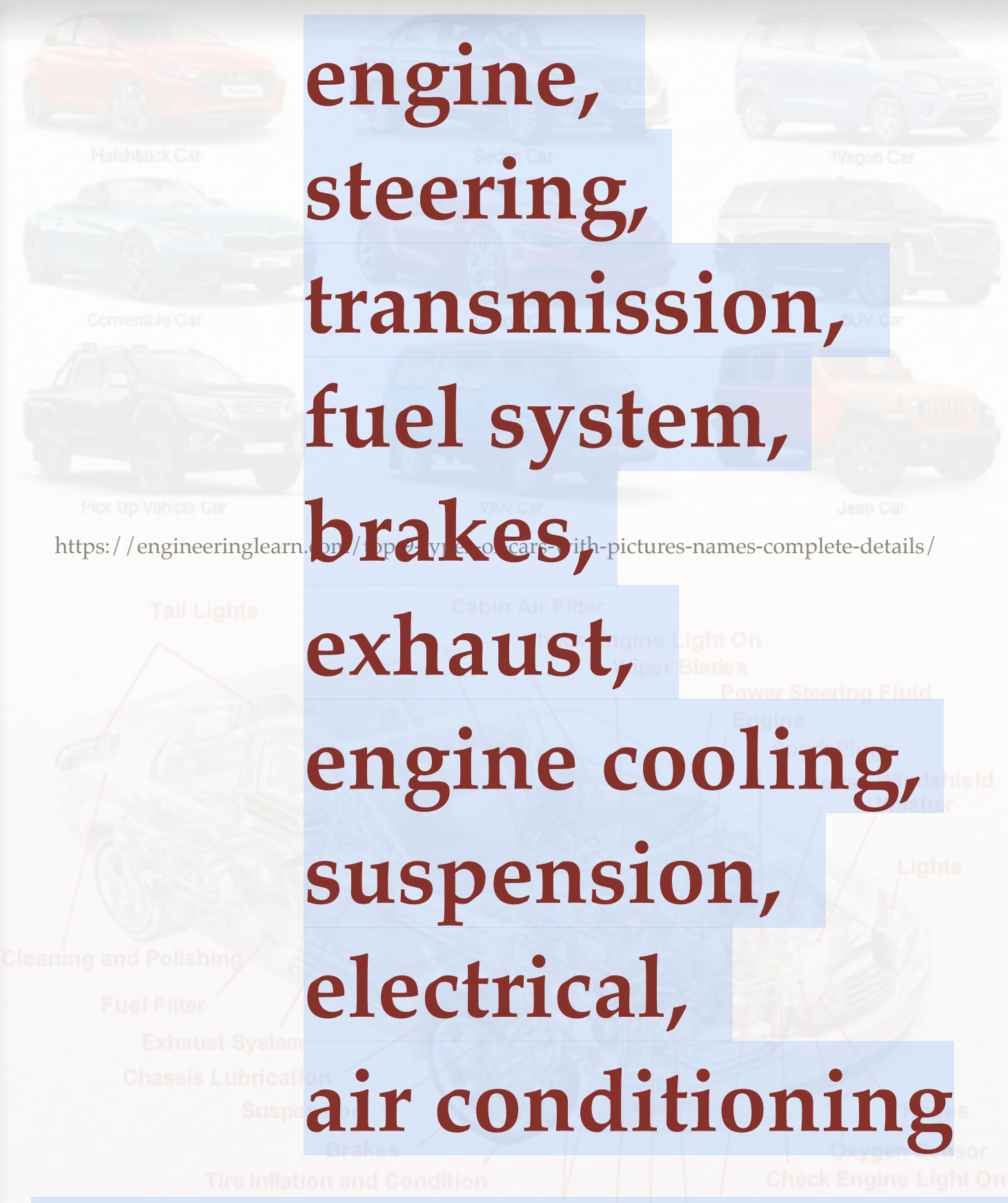


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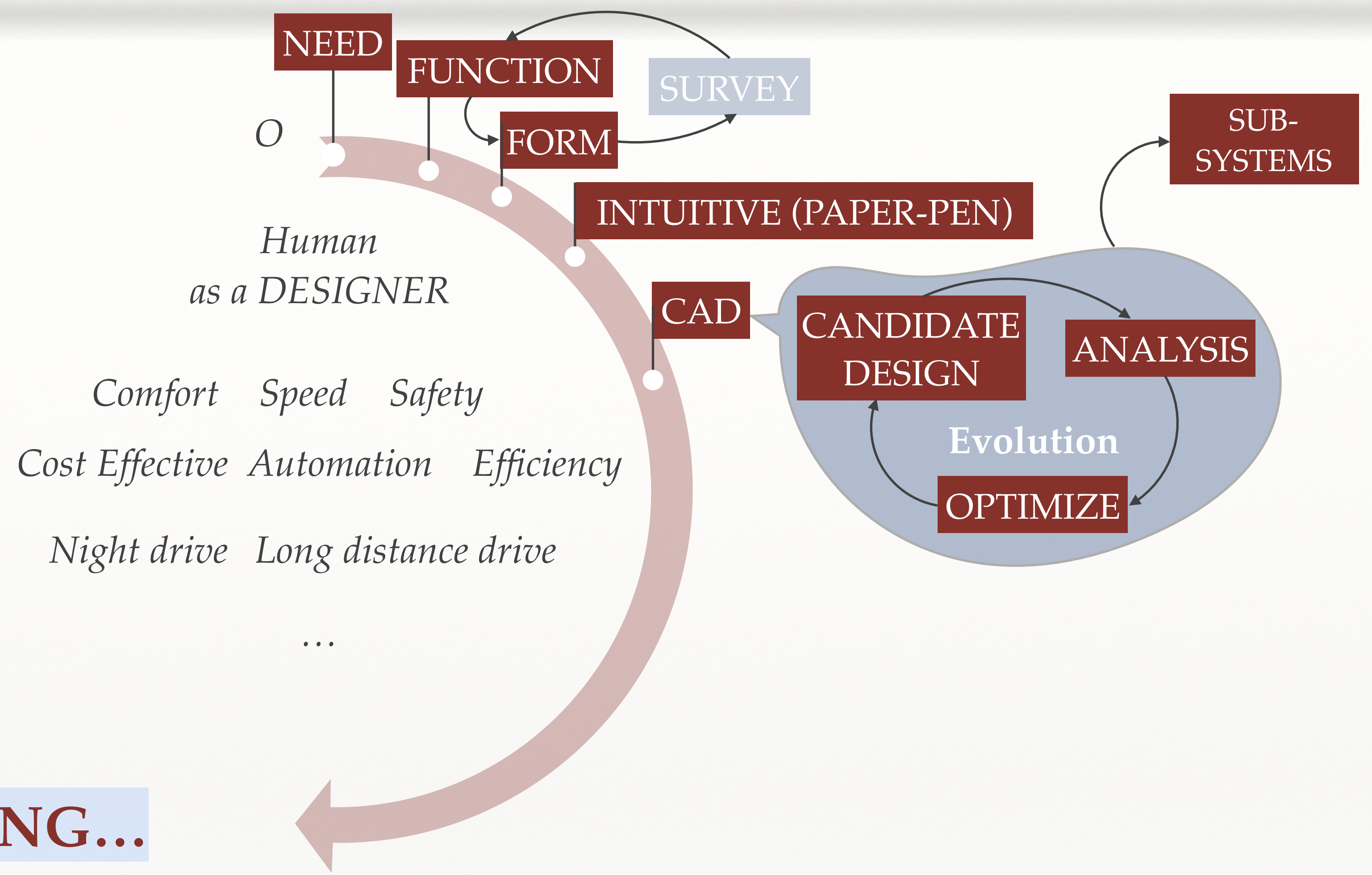
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engine,
steering,
transmission,
fuel system,
brakes,
exhaust,
engine cooling,
suspension,
electrical,
air conditioning

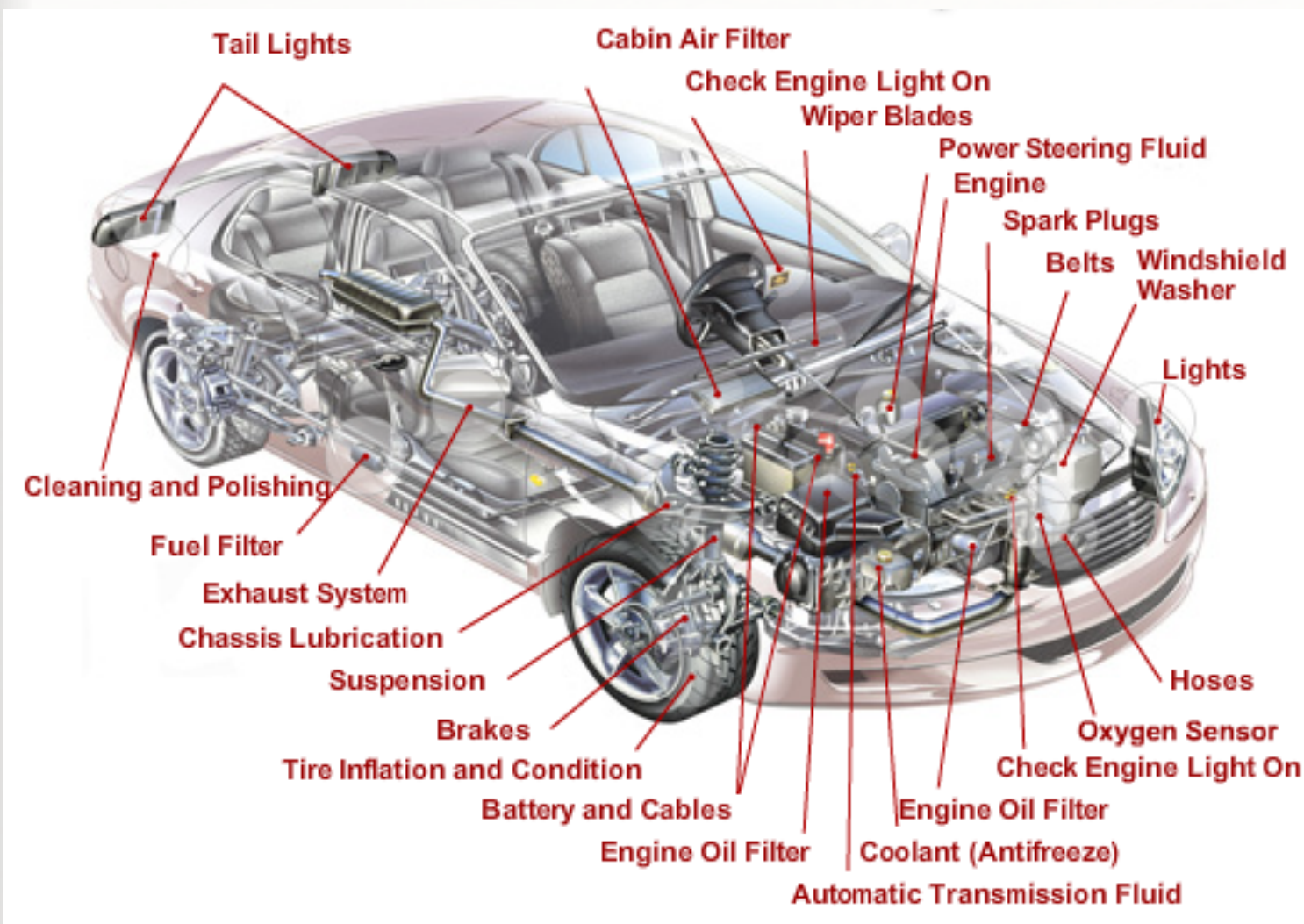
Hybrid, renewable, LPG, CNG...

<https://www.pinterest.de/pin/651685008556791265/>

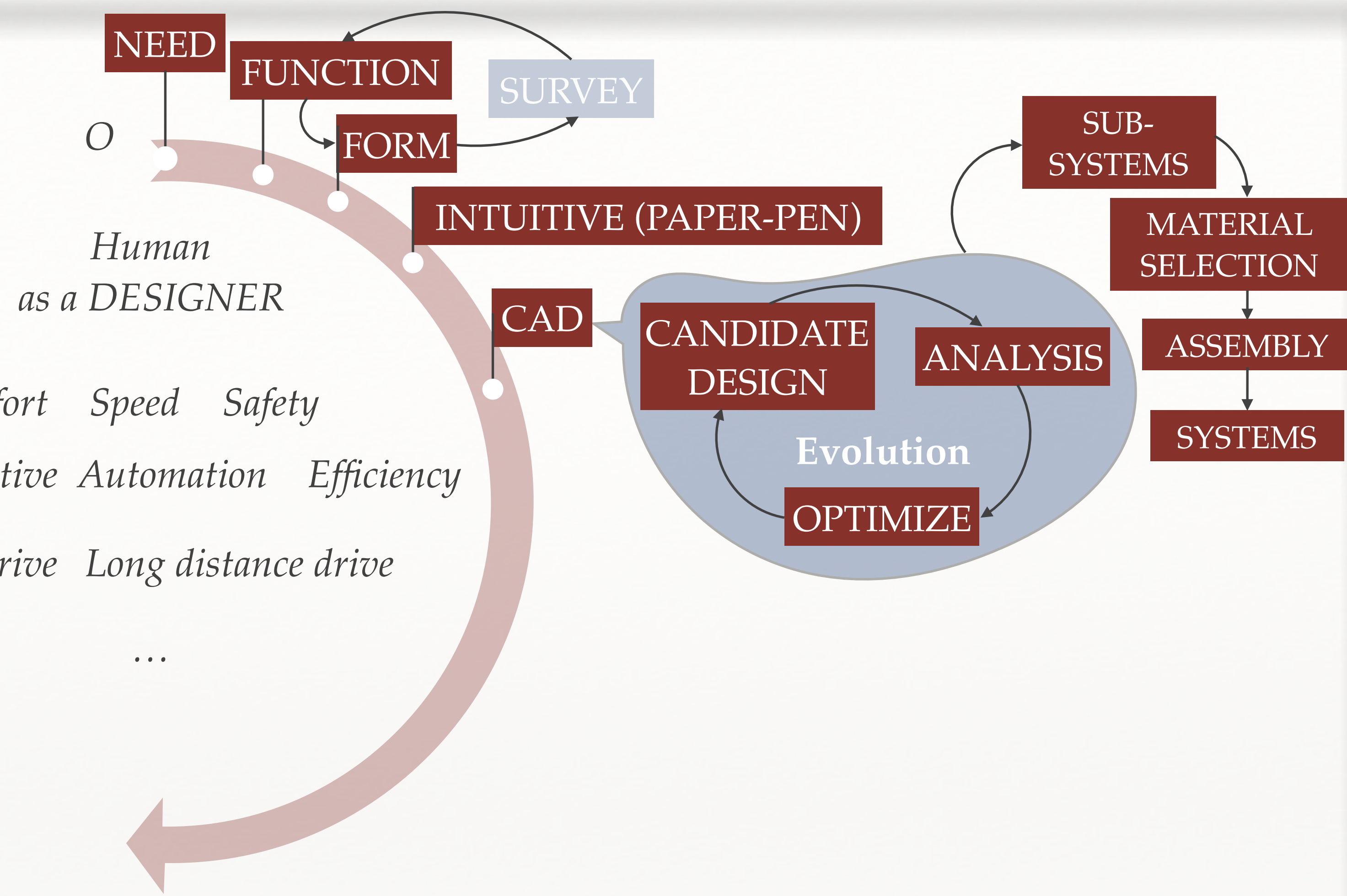


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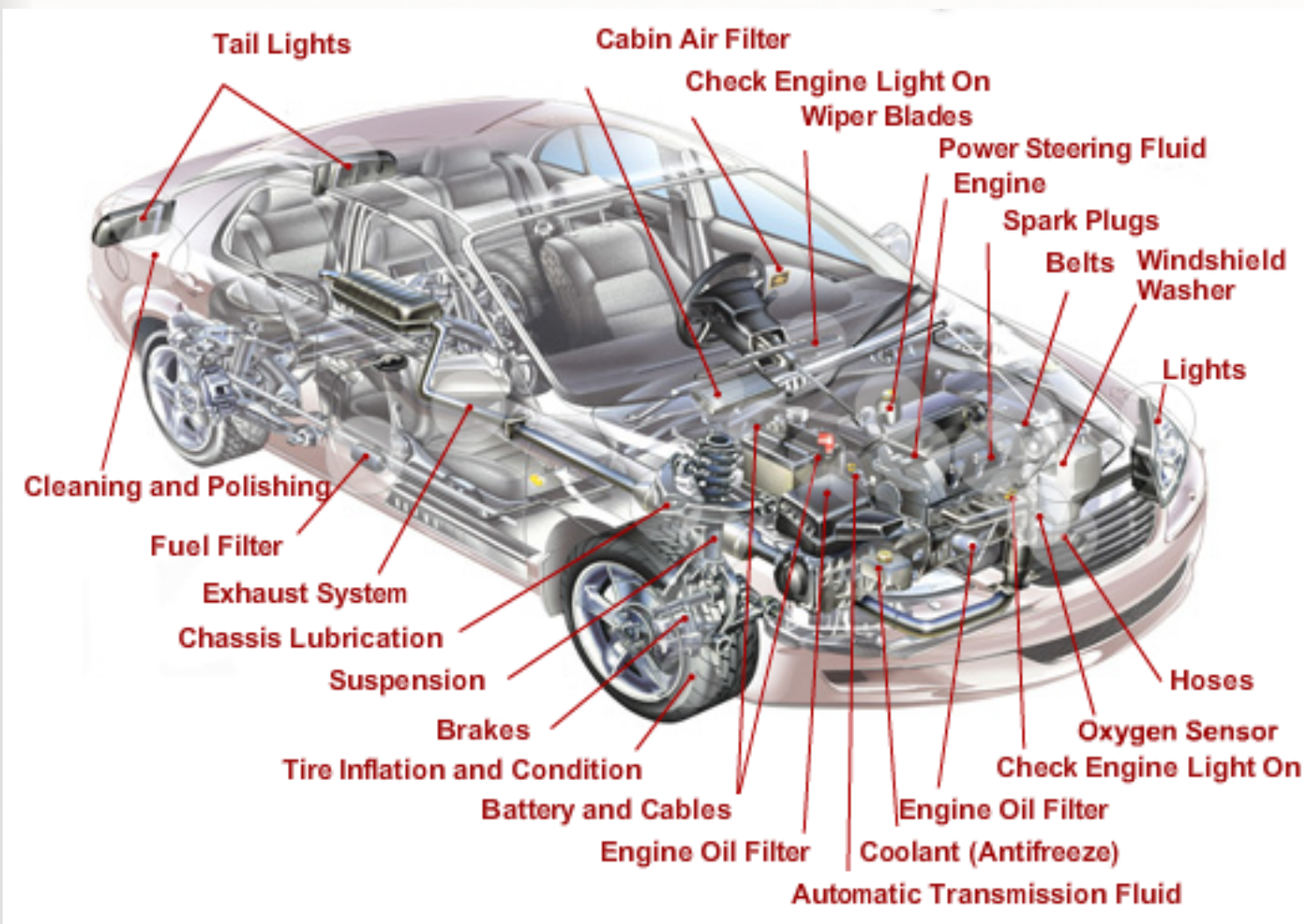


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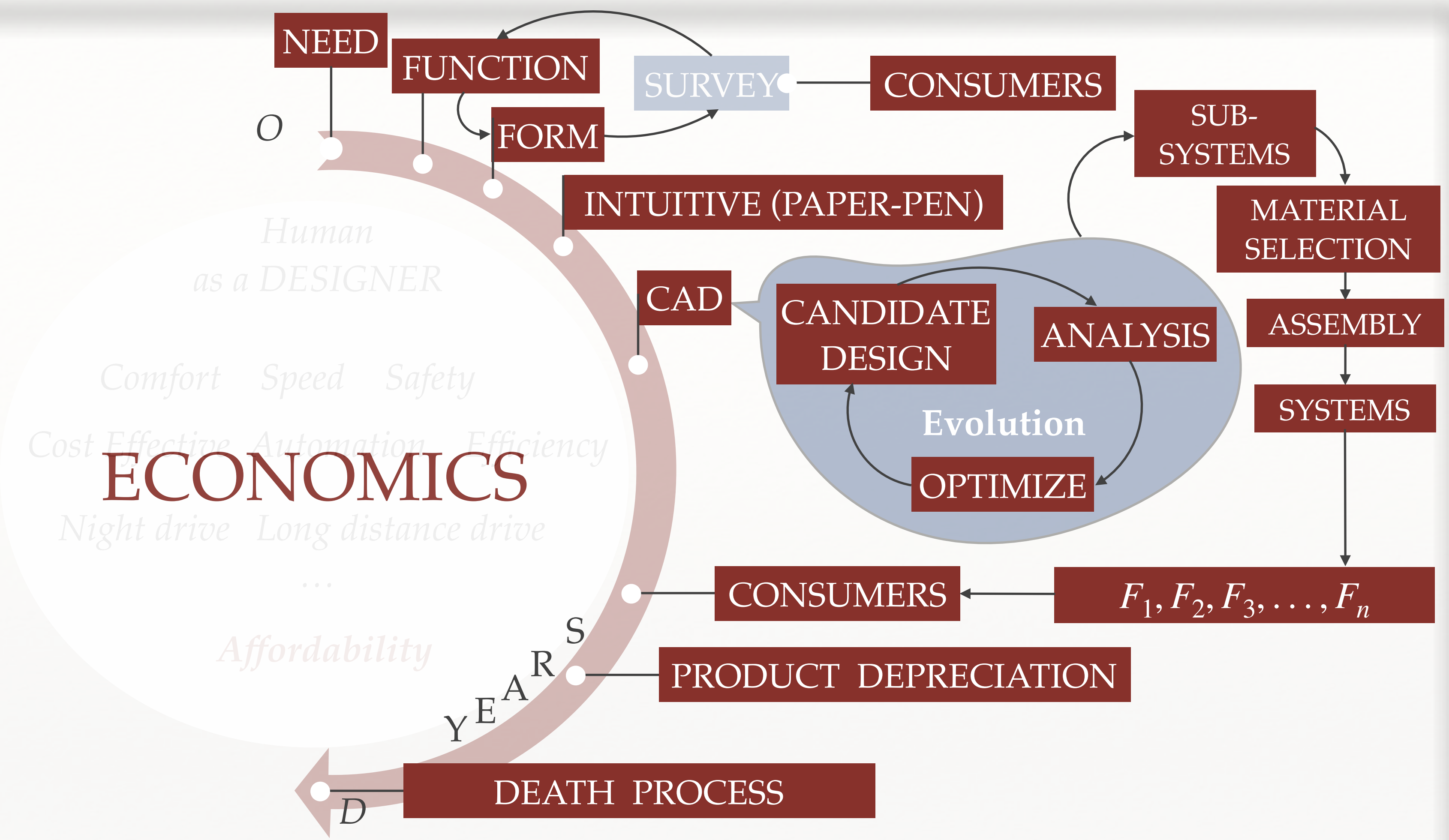


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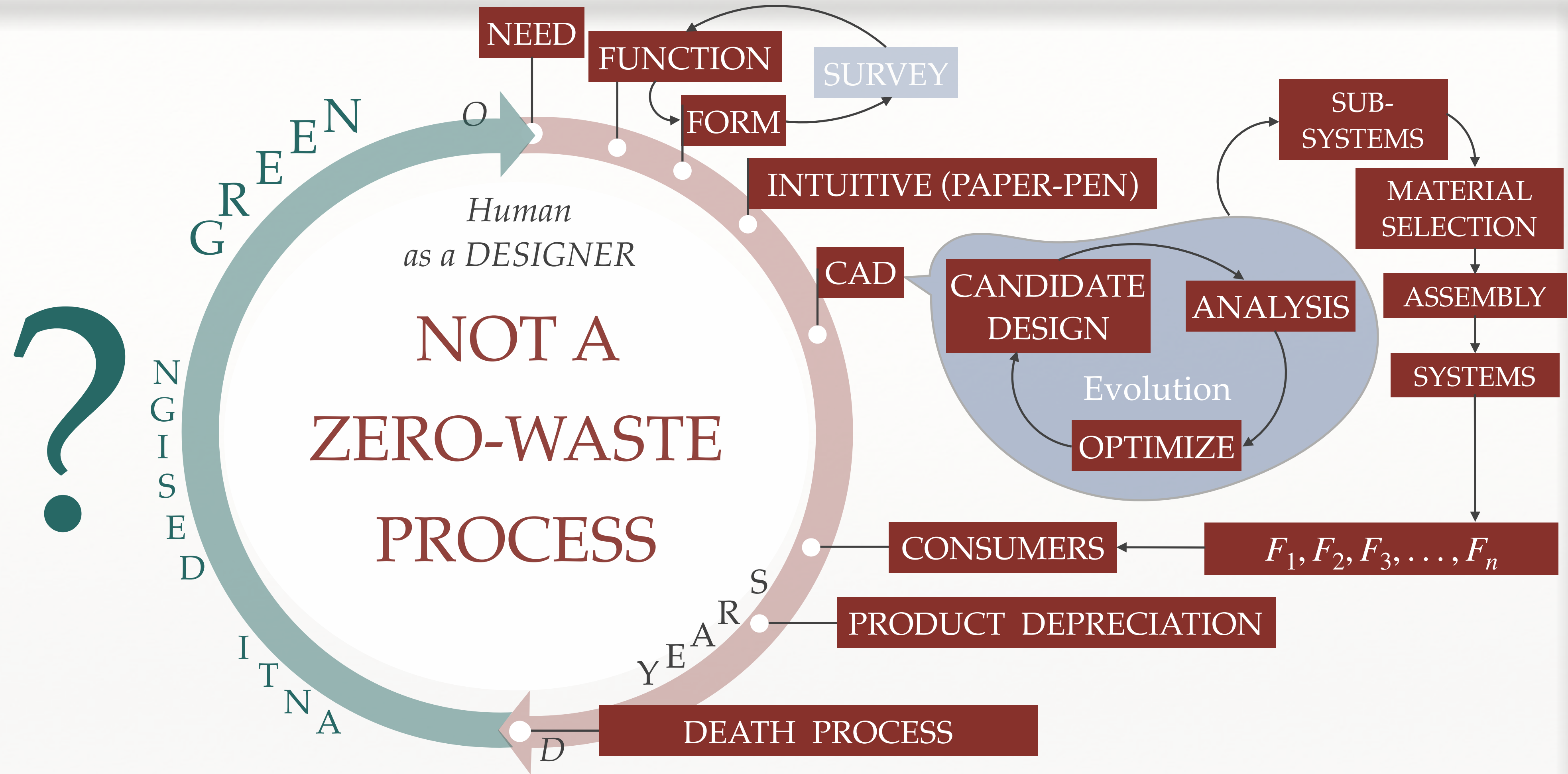


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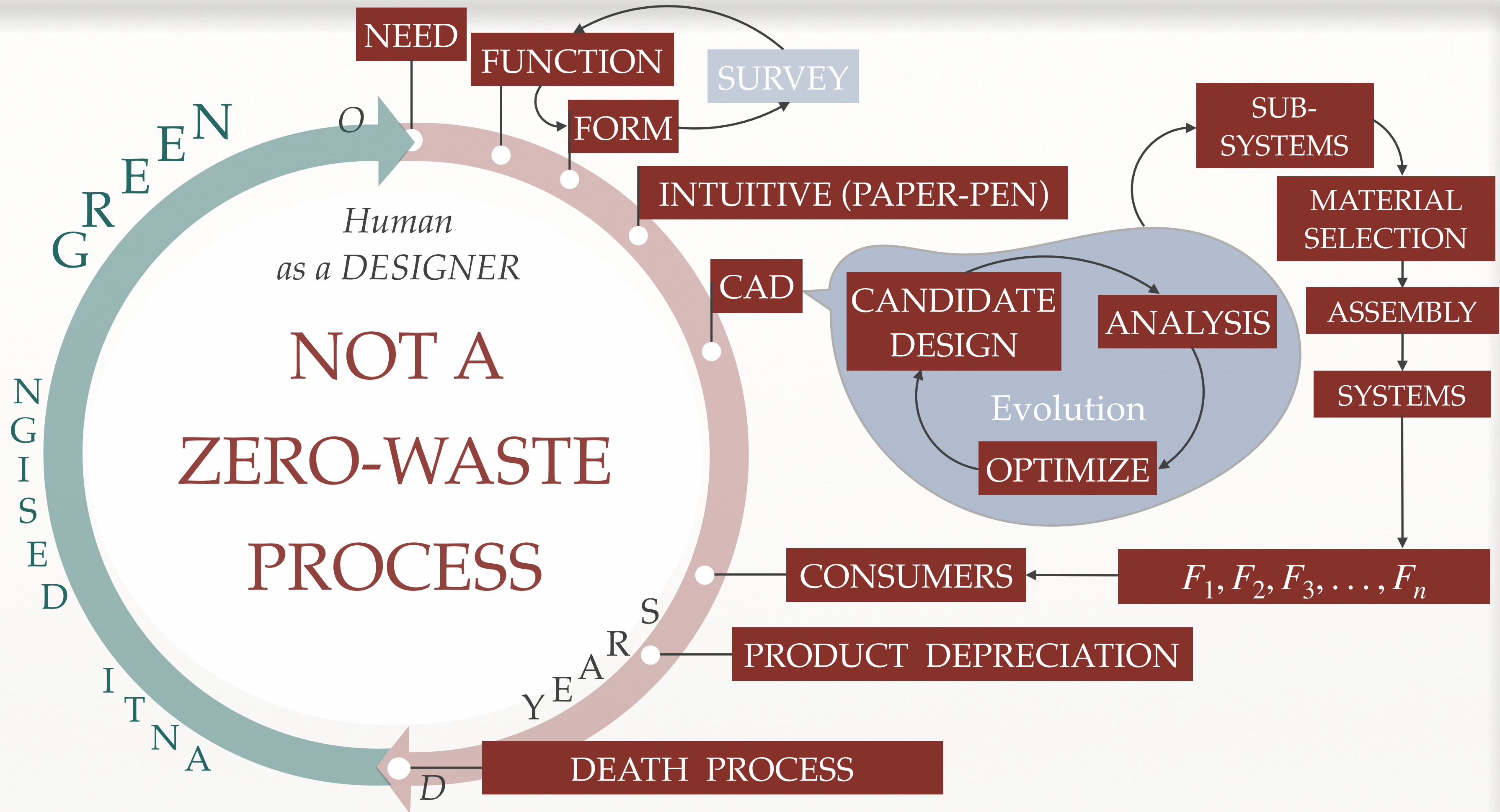
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<https://www.amazon.in/Anatomy-Good-Car-Deal-Happens-ebook/dp/B01M3WYGUJ>

**Dismantling
could be
Economically
Unviable**



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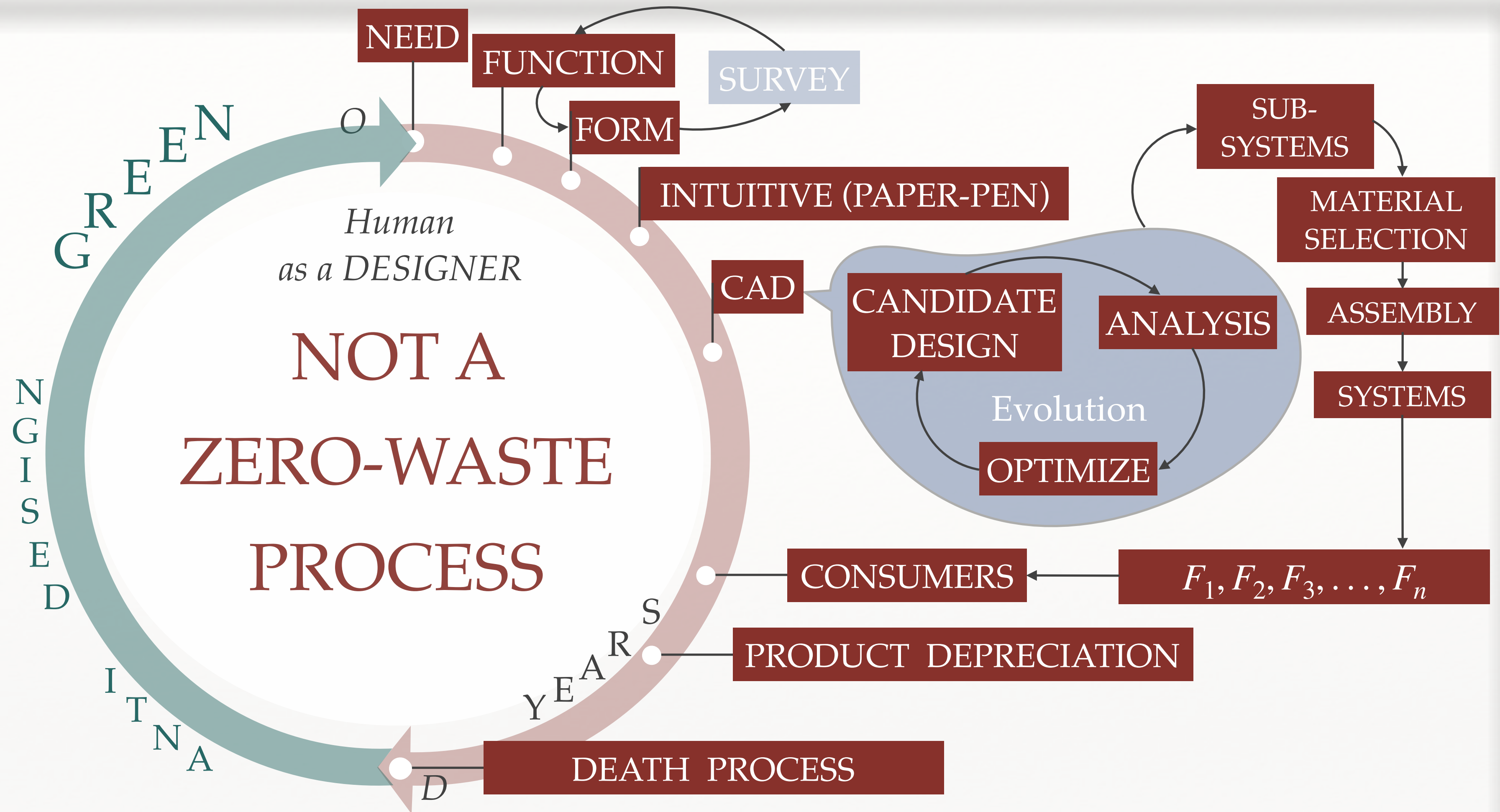


<https://www.amazon.in/Anatomy-Good-Car-Deal-Happens-ebook/dp/B01M3WYGUJ>

Scrap yards



https://knowbestet.life/product_details/71498888.html



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Industrial Model Townships (IMTs)



IMTs are townships with multiple critical part suppliers in proximity to large auto manufacturing plants

Google Maps view of IMT Manesar, just outside Gurugram, Haryana

Suppliers such as Pricol, Denso, AVX Electronics visible, **but no waste management/recycled materials suppliers**

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Excerpt from Walle
Walt Disney Pictures



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Alternatives
Solutions



DESIGNED

GREEN

INTINA

Human
as a DESIGNER

NOT A
ZERO-WASTE
PROCESS

NEED

FUNCTION

SURVEY

FORM

INTUITIVE (PAPER-PEN)

CAD

CANDIDATE
DESIGN

ANALYSIS

Evolution

OPTIMIZE

SUB-
SYSTEMS

MATERIAL
SELECTION

ASSEMBLY

SYSTEMS

CONSUMERS

$F_1, F_2, F_3, \dots, F_n$

PRODUCT DEPRECIATION

YEARS

DEATH PROCESS

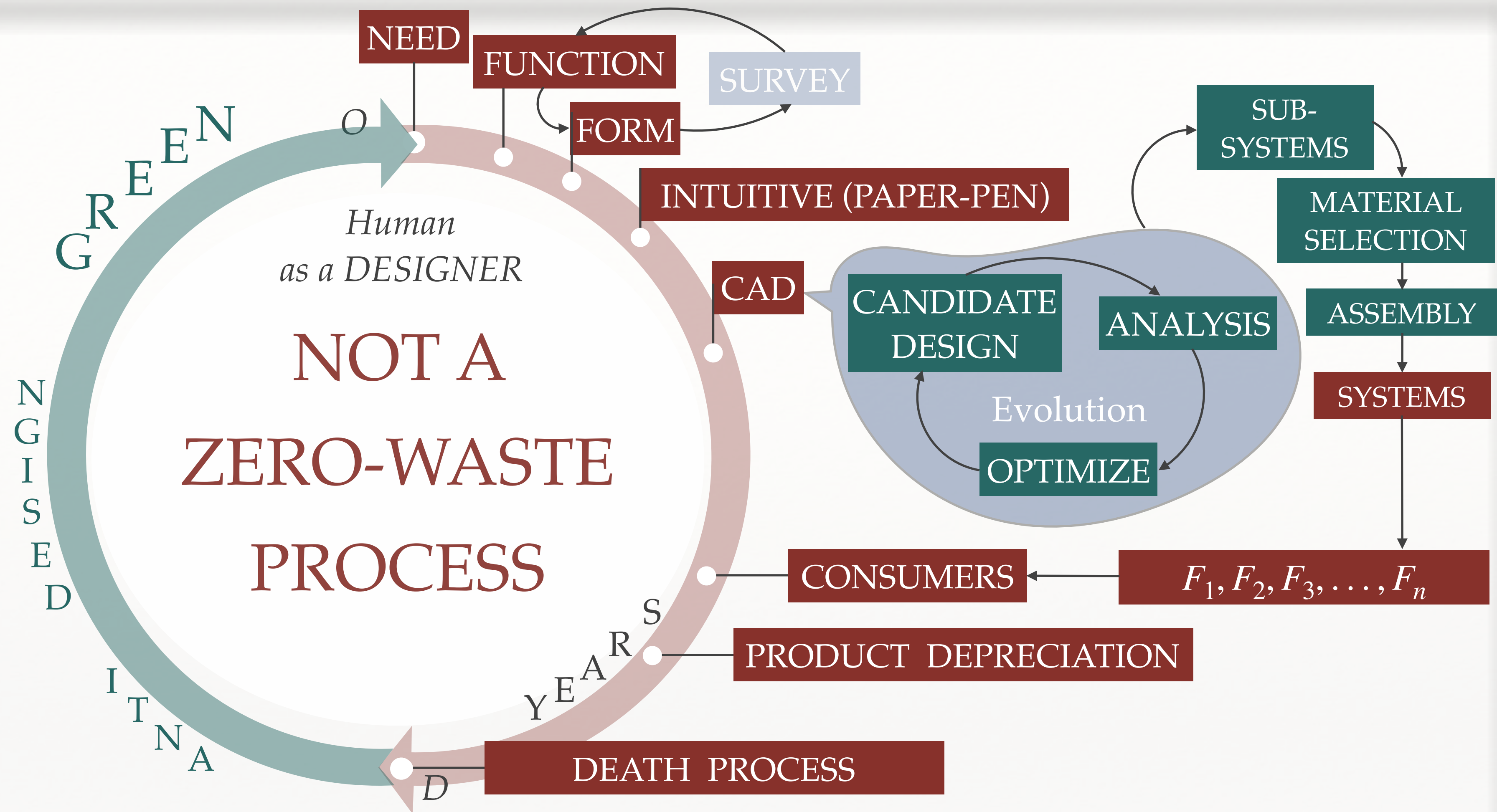
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Professor

Indian Institute of Technology Kanpur

Proper Material Selection
Eliminate Assembly

Alternatives
Solutions



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