

HOT SWAPPING OF THE BATTERY IN A DRONE IN A BOX

ME325 - MECHANICAL ENGINEERING
GROUP PROJECT

GROUP 6



Background

- Drone technology popularity rising, but limited flight time due to battery capacity.

Current state-of-the-art:

- manual battery replacement,
- time-consuming and disruptive.

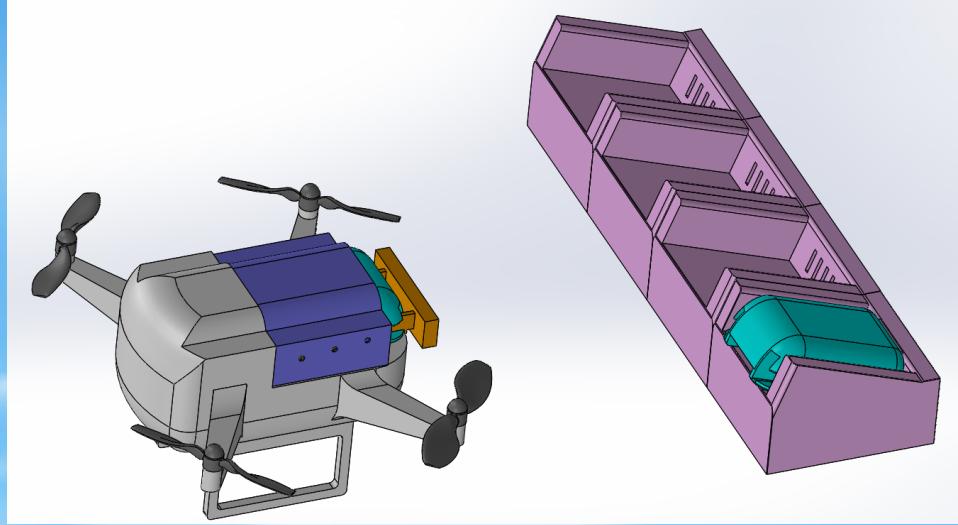
Potential applications:

- Search and rescue operations in remote areas.
- Extended flight times for various drone missions.



What did we did?

- ★ Locking mechanism of the battery
- ★ End-effector with one or two actuators
- ★ Battery holding mechanism for the end-effector
- ★ (Elaborate more)
The fixing mechanism in the charging dock



Limitations we had

End effector Can't use rubber gripper since it needs a Pneumatic system

Charging types Wireless charging is not possible as its charging rate is not sufficient

Space Drone in the box model should be in $2\text{ m} \times 2\text{ m}$ space

Special concerns

■ 01. Weather conditions

Withstand for the weather conditions like rain

■ 02. Aerodynamics

Preventing undesired lift forces

■ 03. Cooling

Maximize the efficiency

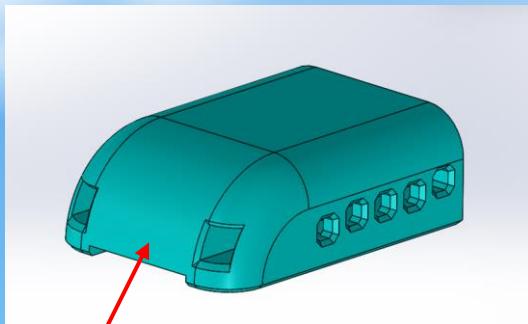
■ 04. End effector

Geometry

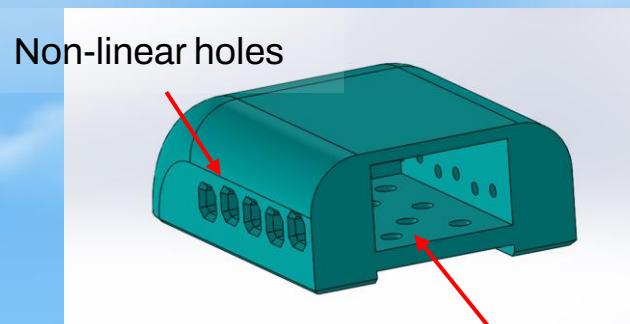
Mechanism



The design we came up

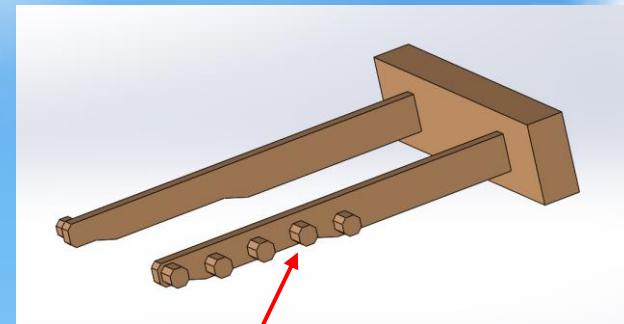


Adaptations for aerodynamics

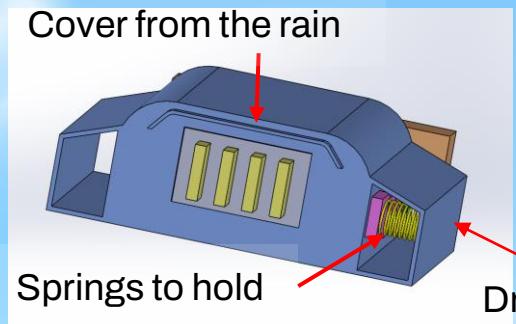


Non-linear holes

For cooling

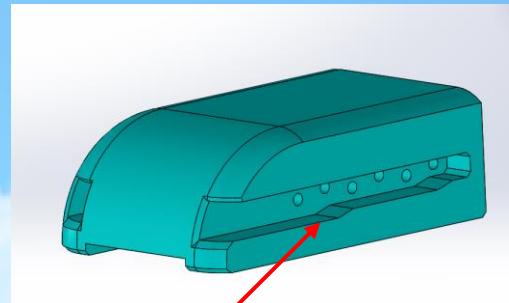


Modifications to fit the end effector



Cover from the rain

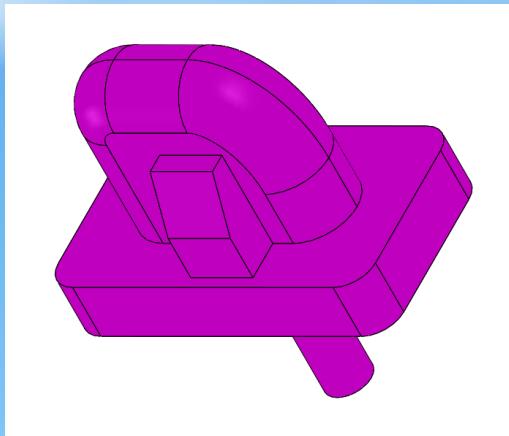
Springs to hold



Drone Cover

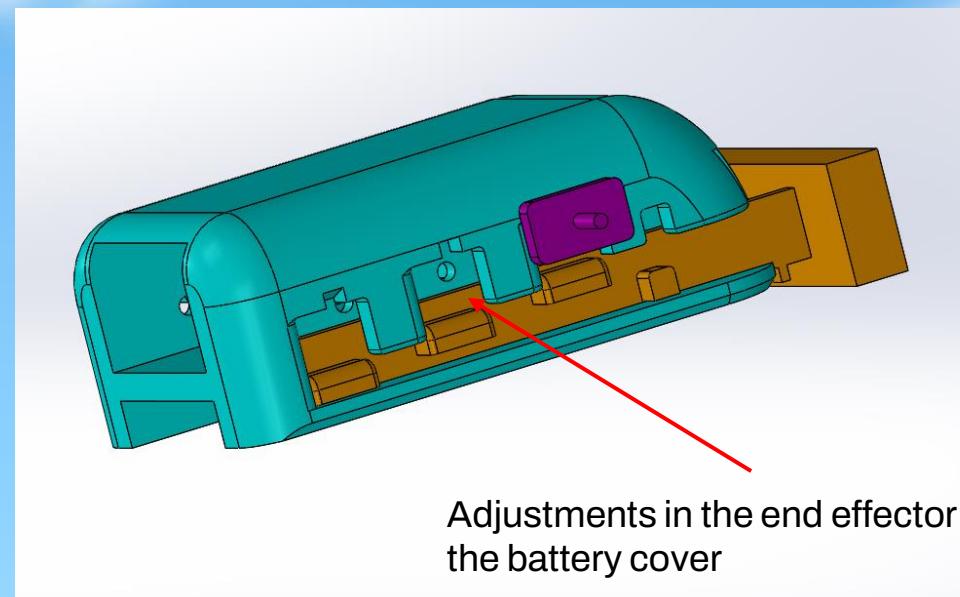
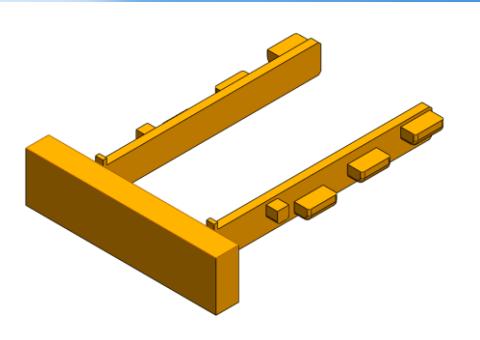
Modifications in battery cover to fit end effector

Final design



Spring loaded part

End effector



Adjustments in the end effector and
the battery cover

The prototype

- **Material:** Wood used for cost-effective prototyping.

- **Benefits of wood prototyping:**

- Cost-effective for initial design testing.
- Allows for quick adjustments and modifications.
- Easy visualization of the locking mechanism.

- **Limitations:**

- Wood may not precisely represent final product's mechanical properties.
- Weight and durability not indicative of the actual product.



SPRING-LOADED PART



ASSEMBLY OF THE DRONE COVER, BATTERY COVER AND THE SPRING-LOADED PART

The prototype

- **Results and Insights:**

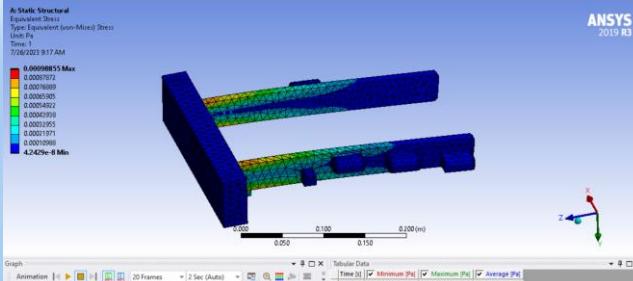
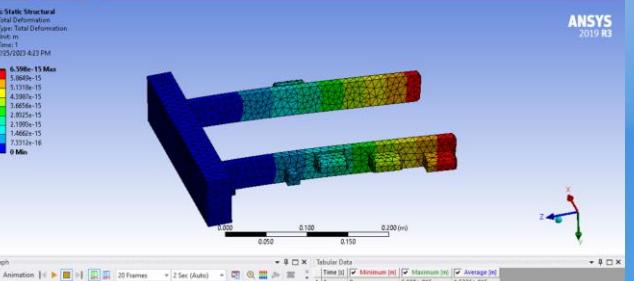
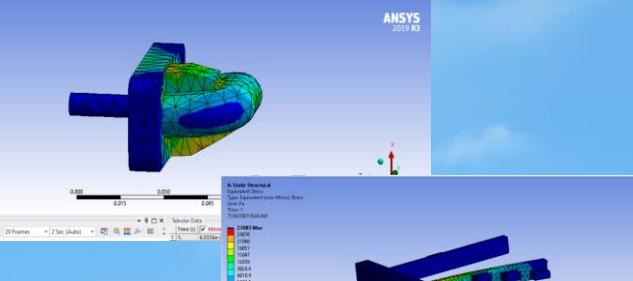
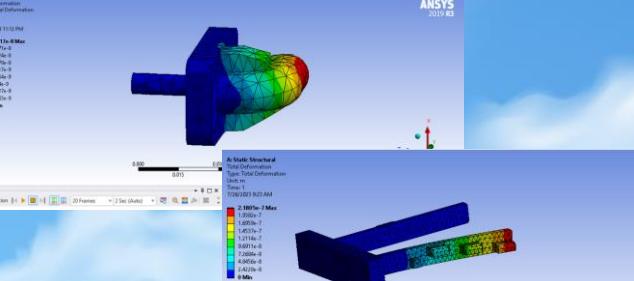
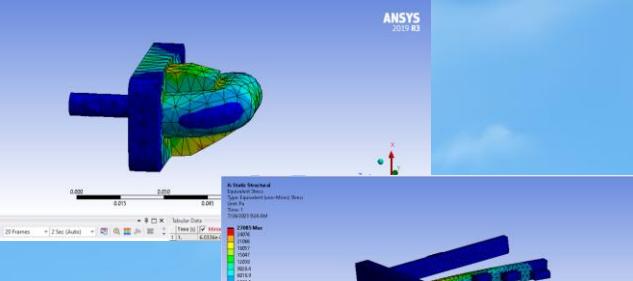
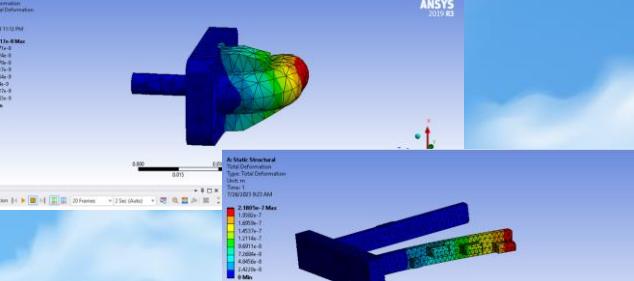
- Assess mating and locking effectiveness.
- Identify potential design improvements.

wood prototyping is useful for initial proof-of-concept and design evaluation

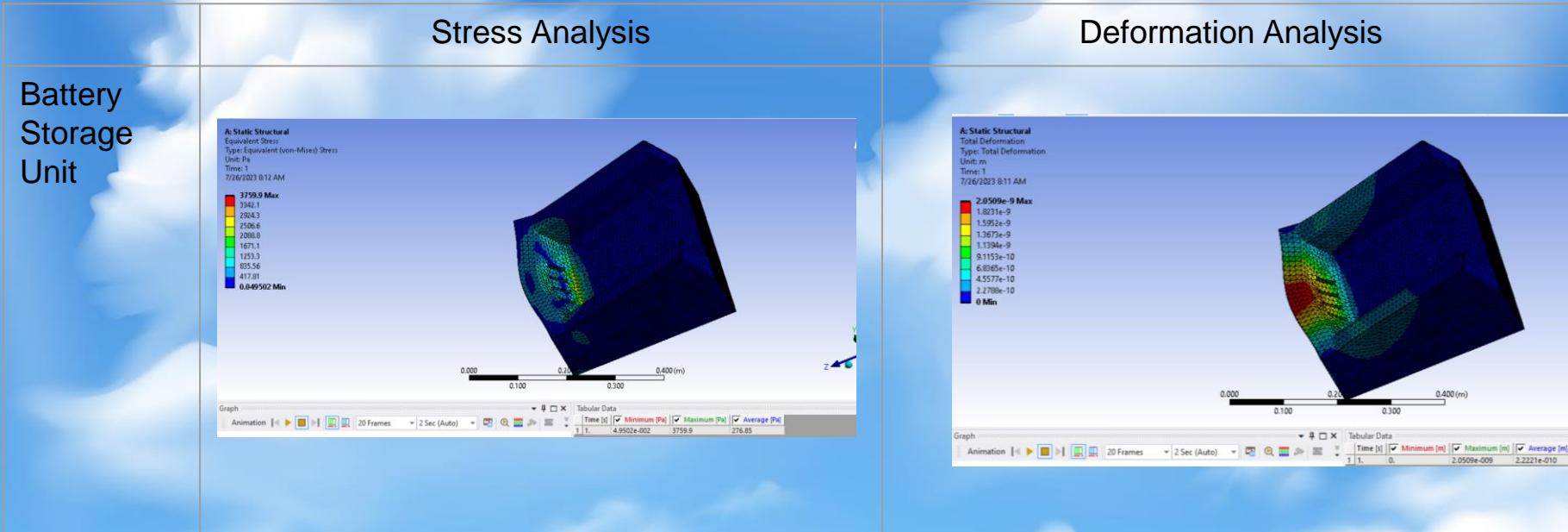


THE DRONE COVER AND THE BATTERY COVER

Simulation Analysis

	Stress Analysis	Defromation Analysis
End effector	 <p>ANSYS 2019 R3 A: Static Structural Equation Stress Type: Equivalent (von-Mises) Stress Unit: Pa Time: 1 7/26/2023 9:17 AM</p> <p>Graph Animation: 20 Frames, 2 Sec (Auto) Tabular Data Time [s]: Minimum [Pa] Maximum [Pa] Average [Pa] 1.1 -4.342e-008 0.0009855 7.297e-005</p>  <p>ANSYS 2019 R3 A: Static Structural Total Deformation Type: Total Deformation Unit: m Time: 1 7/25/2023 4:23 PM</p> <p>Graph Animation: 20 Frames, 2 Sec (Auto) Tabular Data Time [s]: Minimum [m] Maximum [m] Average [m] 1.1 6.986e-15 1.5326e-015 1.5326e-015</p>	 <p>ANSYS 2019 R3 A: Static Structural Equation Stress Type: Equivalent (von-Mises) Stress Unit: Pa Time: 1 7/26/2023 11:11 AM</p> <p>Graph Animation: 20 Frames, 2 Sec (Auto) Tabular Data Time [s]: Minimum [Pa] Maximum [Pa] Average [Pa] 1.1 6.879e-1 21000 11500</p>  <p>ANSYS 2019 R3 A: Static Structural Total Deformation Type: Total Deformation Unit: m Time: 1 7/26/2023 11:11 AM</p> <p>Graph Animation: 20 Frames, 2 Sec (Auto) Tabular Data Time [s]: Minimum [m] Maximum [m] Average [m] 1.1 5.137e-8 0.00030344 0.00030344</p>
Mechanism	 <p>ANSYS 2019 R3 A: Static Structural Equation Stress Type: Equivalent (von-Mises) Stress Unit: Pa Time: 1 7/26/2023 11:11 AM</p> <p>Graph Animation: 20 Frames, 2 Sec (Auto) Tabular Data Time [s]: Minimum [Pa] Maximum [Pa] Average [Pa] 1.1 0.00030344 21000 11500</p>  <p>ANSYS 2019 R3 A: Static Structural Total Deformation Type: Total Deformation Unit: m Time: 1 7/26/2023 11:11 AM</p> <p>Graph Animation: 20 Frames, 2 Sec (Auto) Tabular Data Time [s]: Minimum [m] Maximum [m] Average [m] 1.1 2.1805e-7 2.3254e-008 2.3254e-008</p>	

Simulation Analysis



Results

- Compact
- Easy to handle
- Has a reasonable purchasing/maintenance cost
- Ensure the safe operation of the UAV during airborne flights



Our team



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THANK YOU!

Features of the topic

Mars

Mars is actually a very cold place

Jupiter

It's the biggest planet in the Solar System

Venus

Venus has extremely high temperatures

Saturn

Saturn is a gas giant and has several rings



Examples

Mercury

It's the closest and the smallest planet in the Solar System

Mars

Despite being red, Mars is actually a cold place. It's full of iron oxide dust

Venus

Venus has a beautiful name and is the second planet from the Sun



Recommendations

Mars

Mars is actually a very cold place

Mercury

It's the closest planet to the Sun

Neptune

It's the farthest planet from the Sun

Jupiter

It's the biggest planet of them all

Venus

It has extremely high temperatures

Saturn

It's a gas giant with several rings



Awesome WORDS





“This is a quote, words full of wisdom that someone important said and can make the reader get inspired.”

—Someone Famous

Practical exercise

Images reveal large amounts of data, so remember: use an image instead of a long text.
Your audience will appreciate it for sure



12 M

Big numbers catch your audience's attention



9h 55m 23s

Jupiter's rotation period

333,000

The Sun's mass compared to Earth's

386,000 km

Distance between Earth and the Moon

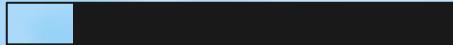


Percentages about drones



50% **Mercury**

It's the closest planet to the Sun and the smallest of them all



75% **Venus**

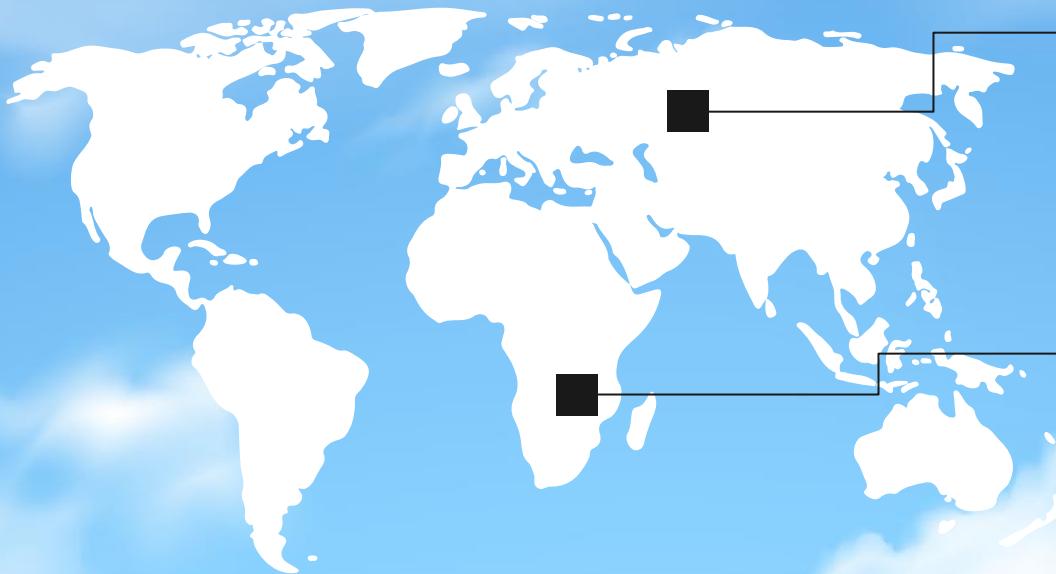
It has a beautiful name and is the second planet from the Sun



25% **Mars**

Mars is actually a cold place. It's full of iron oxide dust

Where we are



Mercury

It's the closest planet to the Sun

12,290 centers

Mars

Mars is in fact a very cold place

5,120 centers

Our organizers



Tommy Ford

You can speak a bit
about this person here



Sofia Hill

You can speak a bit
about this person here



Our events timeline

Venus

It's the second planet from the Sun

1980

1990

Mercury

It's the closest planet to the Sun

Jupiter

It's the biggest planet of them all

1980

1990

Mars

Despite being red, Mars is a cold place

We still going

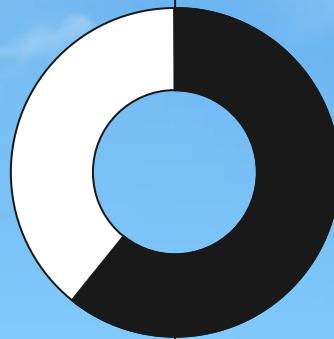
Now

About events

\$ 500,000

Venus

Venus is the second planet from the Sun. It's hot and is the second brightest natural object in the night sky

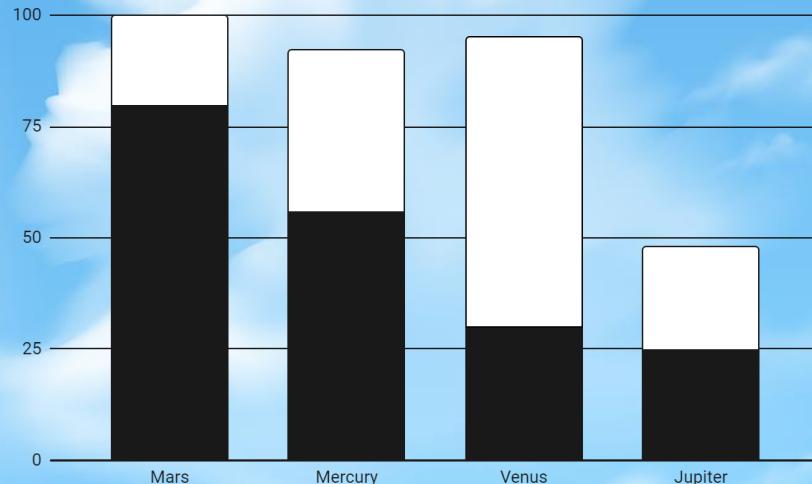


Mercury

Mercury is the smallest planet. This planet's name has nothing to do with the liquid metal

\$ 900,000

Events comparison



First Year

Despite being red, Mars is a cold place. It's full of iron oxide dust

Second Year

Earth is the third planet from the Sun and the only that has life

Follow the link in the graph to modify its data and then paste the new one here. [For more info, click here](#)

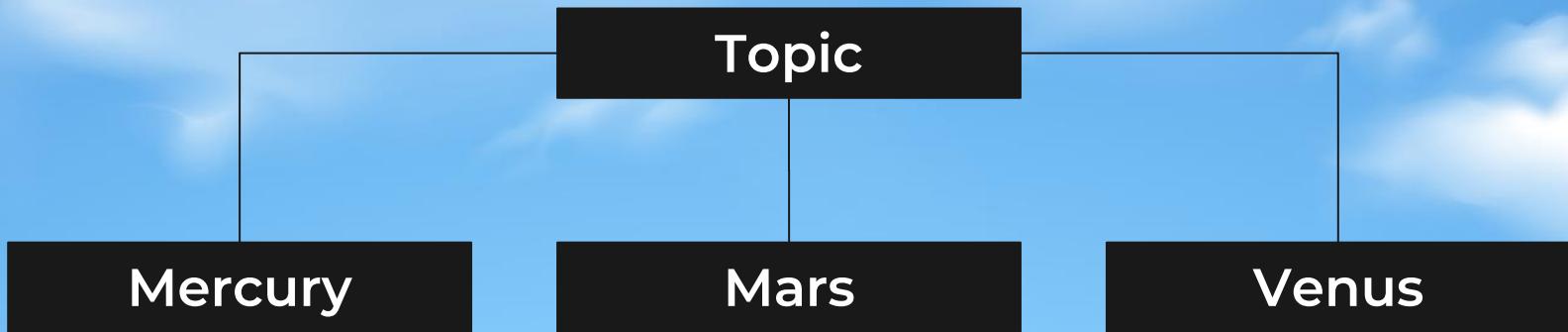
Power thinking

A	
B	
C	Ceres
D	
E	Eris
F	
H	

G	
I	
J	Jupiter
K	
L	
M	Mars
N	Neptune
O	
P	

P	
Q	
R	
S	Saturn
T	
U	
V	Venus
W	
X	
Y	
Z	

Main topic & details



Mercury is the closest planet to the Sun and the smallest one

Despite being red, Mars is actually a cold place. It's full of iron oxide dust

Venus has a beautiful name and is the second planet from the Sun

Sequence

First

It's the closest planet to the Sun

Next

It's the smallest planet of them all

Next

Mars is actually a very cold place

Next

It's the biggest planet of them all

Next

Saturn is a gas giant and has rings

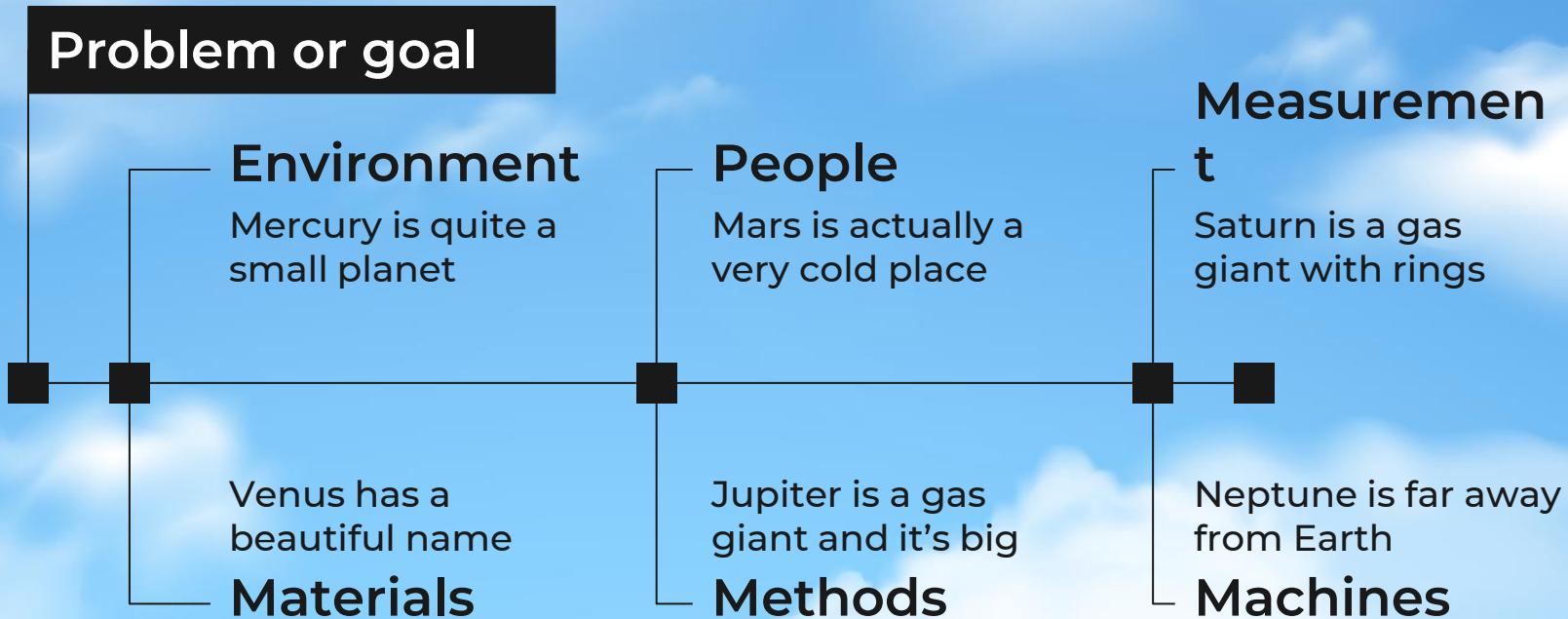
Last

Neptune is very far away from Earth

Classifying

Mars	Venus	Mercury	Jupiter
<ul style="list-style-type: none">• Small• Red• Cold• Rocky	<ul style="list-style-type: none">• Small• Hot• Dry• Volcanic	<ul style="list-style-type: none">• Small• Hot• Rocky• Cratered	<ul style="list-style-type: none">• Large• Cold• Gassy• Stripped
Mars is actually a very cold place	Venus has a beautiful name	Mercury is a very small planet	Jupiter is a very big planet

Cause & effect



Question & answer

Question

Is Mercury the closest planet to the Sun and the smallest one in the Solar System? Note that it's a bit larger than the Moon



Answer

Venus has a beautiful name and is the second planet from the Sun. It's hot and has a poisonous atmosphere

Parts & whole

The whole object

Mercury is the closest planet to the Sun and the smallest one in the entire Solar System. This planet's name has nothing to do with the liquid metal

Parts of the object

- Mercury
- Pluto
- Venus
- Mars
- Earth
- Moon
- Jupiter
- Saturn

What's the function of the part?

Saturn is a gas giant and has several rings. It's composed of hydrogen and helium

What would happen if the parts were missing

It has a beautiful name and is the second planet from the Sun. It's hot and has a poisonous atmosphere

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Vectors

- Yellow drone with remote control
- Blue logistics post drone realistic composition
- Military drone with bomb realistic composition
- Isolated police drone realistic composition



Resources

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Vectors

- Realistic drone in sky illustration
- Realistic flying drone
- Colored and realistic drone with camera composition
- Two drone with camera realistic transparent icon set

Photos

- Man's hand holding drone outdoors
- Medium shot blurry man with drone outdoors I
- Medium shot smiley man with drone outdoors II



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#ffffff

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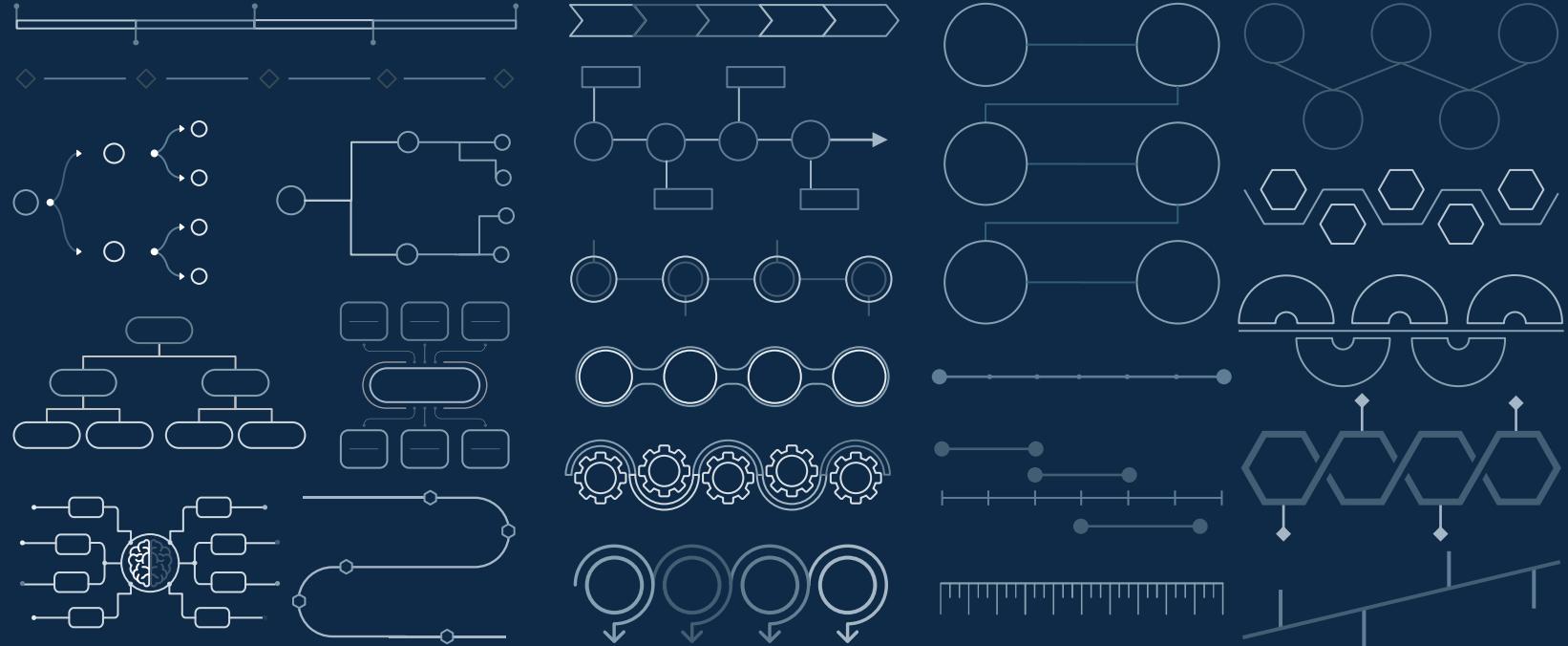
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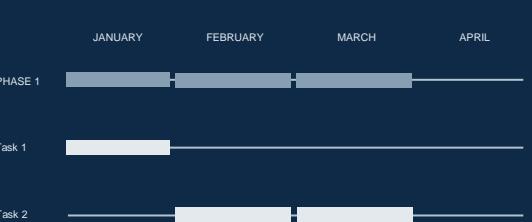
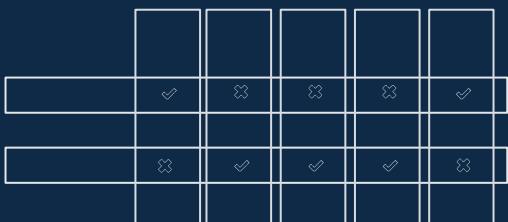
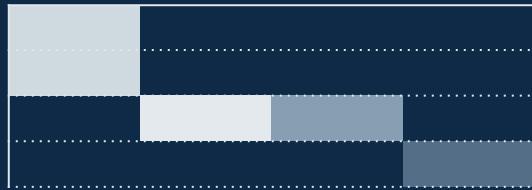
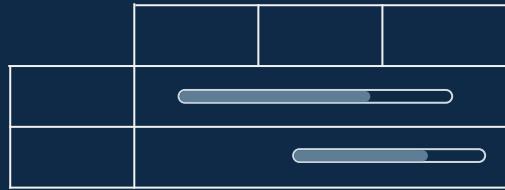
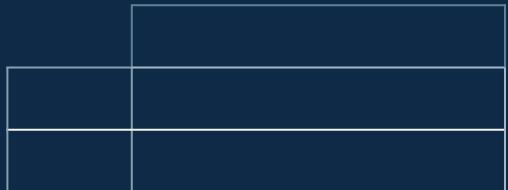
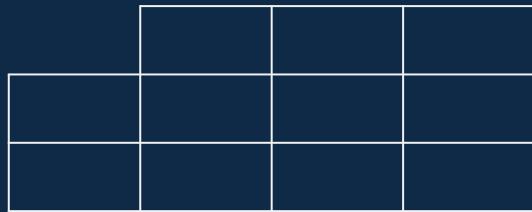
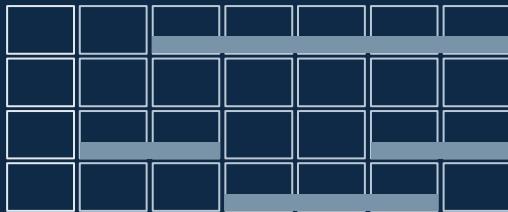
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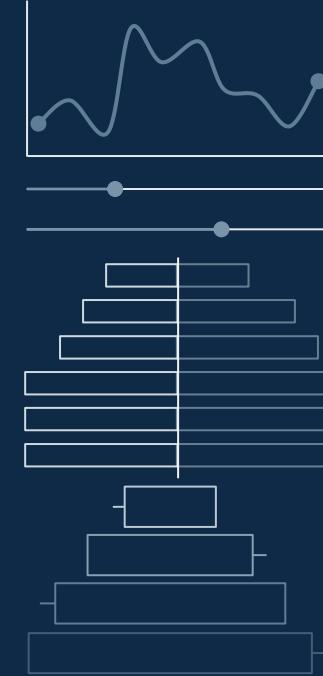
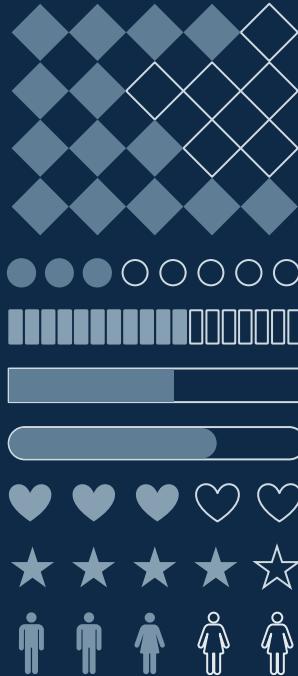
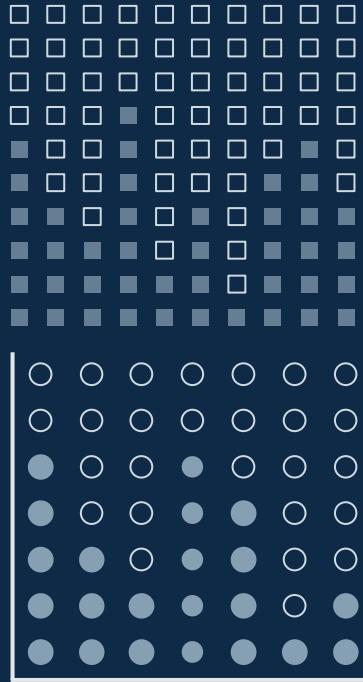












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