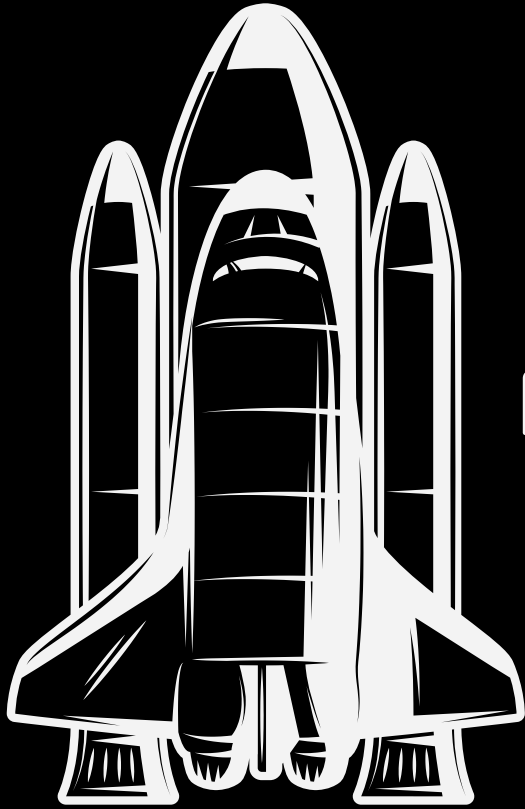




universidade de aveiro  
theoria poiesis praxis



# Sistemas de Telemetria

## NASA Space Shuttle

Aviônica e Espaciônica

Magner Gusse  
Max Taranov

110180  
107781



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Tipos de dados  
de telemetria

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transmissão

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0001

01



# Tipos de Dados

0002

# O que são dados de Telemetria?

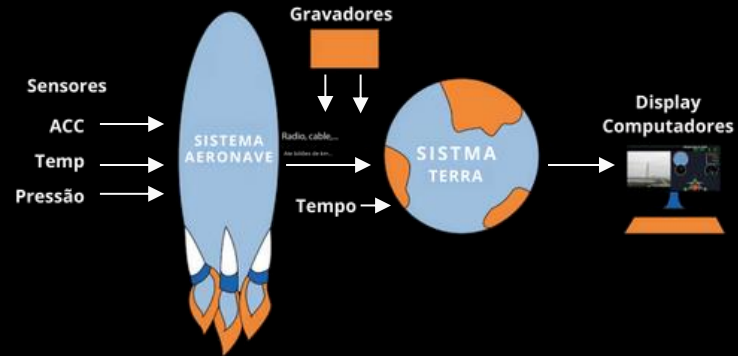
## Definição:

- Coleta e transmissão de dados em tempo real de sistemas remotos
- Crítico para o monitoramento e tomada de decisões durante as operações

## Objetivo:

- Garantir uma melhor segurança operacional
- Otimizar o desempenho
- Coletar informações científicas

### Sistema de Telemetria



[1] <https://dewesoft.com/blog/nasa-pcm-telemetry-processing-station>

# Dados transmitidos

## Sistemas de Propulsão



Monitoramento dos motores principais e dos propulsores auxiliares (SRBs).

## Sistemas estruturais e Mecânicos



Tensão e deformação em componentes críticos.



## Dinâmica de Voo e Navegação

Guiagem inercial e sistemas de controlo de voo.



## Payload e Carga Útil

Dados relacionados a experimentos e cargas científicas transportadas.



0004

# Dados Transmítidos



## Estado de saúde da Tripulação

Dados biométricos como: Frequência Cardíaca, temperatura corporal



## Ambiente da Cabine

Monitoramento da temperatura, humidade e gases na cabine.



## Sistemas de comunicação

Status dos links de dados, antenas e transmissão via TDRSS.

# Importância e Integração dos Dados

## Monitoramento em Tempo Real

Análise contínua para decisões críticas com respostas rápidas, prevenindo falhas catastróficas.

## Análise e estudo pós Missão

Os Dados da missão são analisados e estudados de modo a haver um melhoramento nas missões futuras.

## Integração dos Dados entre Subsistemas

Asseguramento que as decisões sejam baseadas num panorama completo, e não apenas em informações isoladas



# Métodos de transmissão



# Sistemas de Comunicação



## Banda-S

- Sistemas Críticos:
- Transmissão de Voz
  - Comandos da Ground Station
  - Sistemas de alimentação e propulsão
  - Ambiente de Cabine



## Banda-Ku

- Sistemas secundários :
- Transmissão de Vídeo
  - Dados de Payload
  - Informação detalhada da banda S



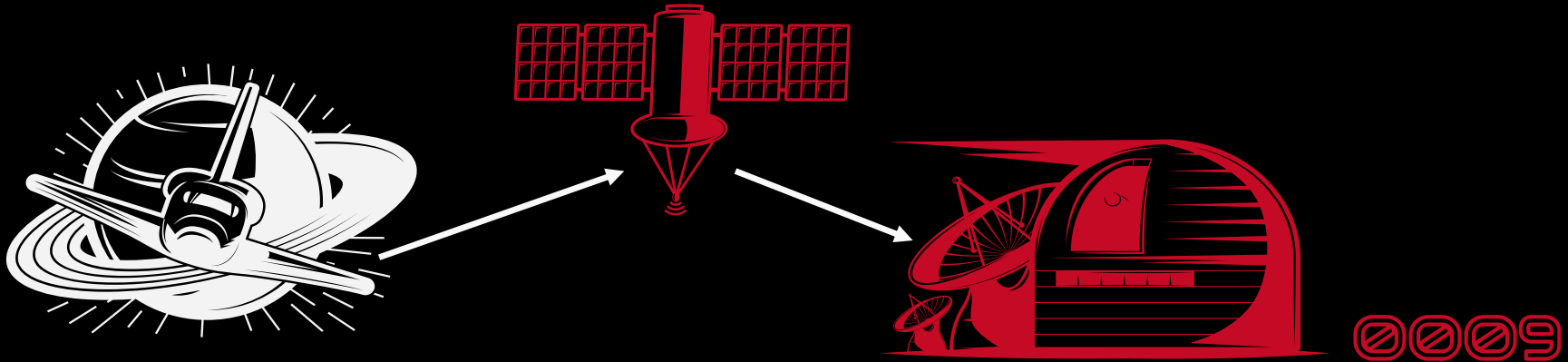
## UHF

- Comunicação a curta distância:
- Comunicação durante a reentrada
  - Comunicação durante as caminhadas espaciais

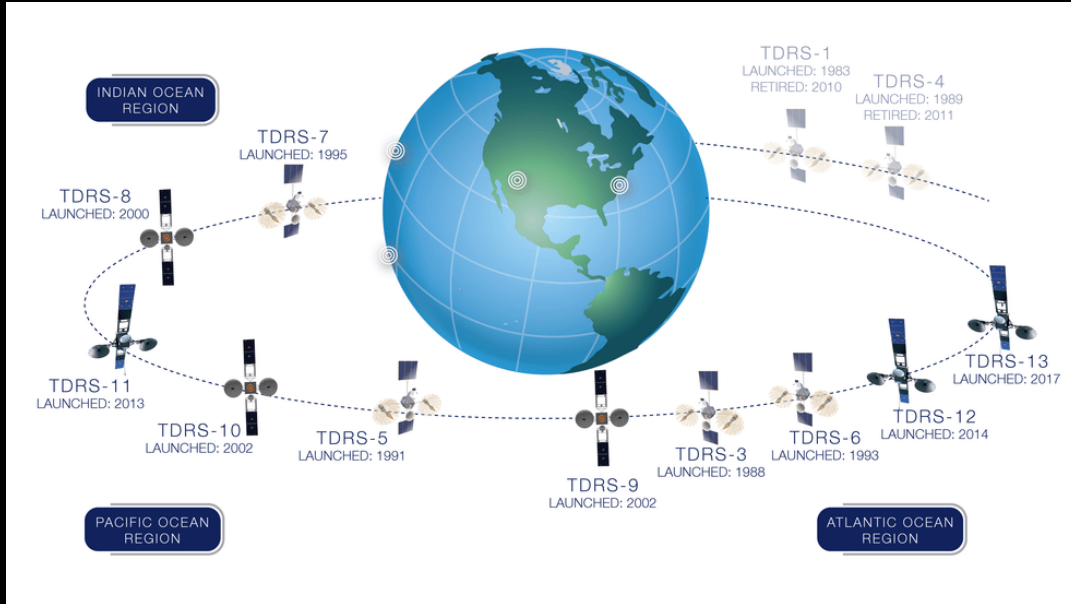
# TDRSS-Tracking and Data Relay Satellite System

Consiste na transmissão de dados de telemetria da missão através de satélites em órbita geossíncrona.

- ▶ Dados são enviados do Shuttle para os satélites
- ▶ Os satélites enviam os mesmos dados para as Ground Stations



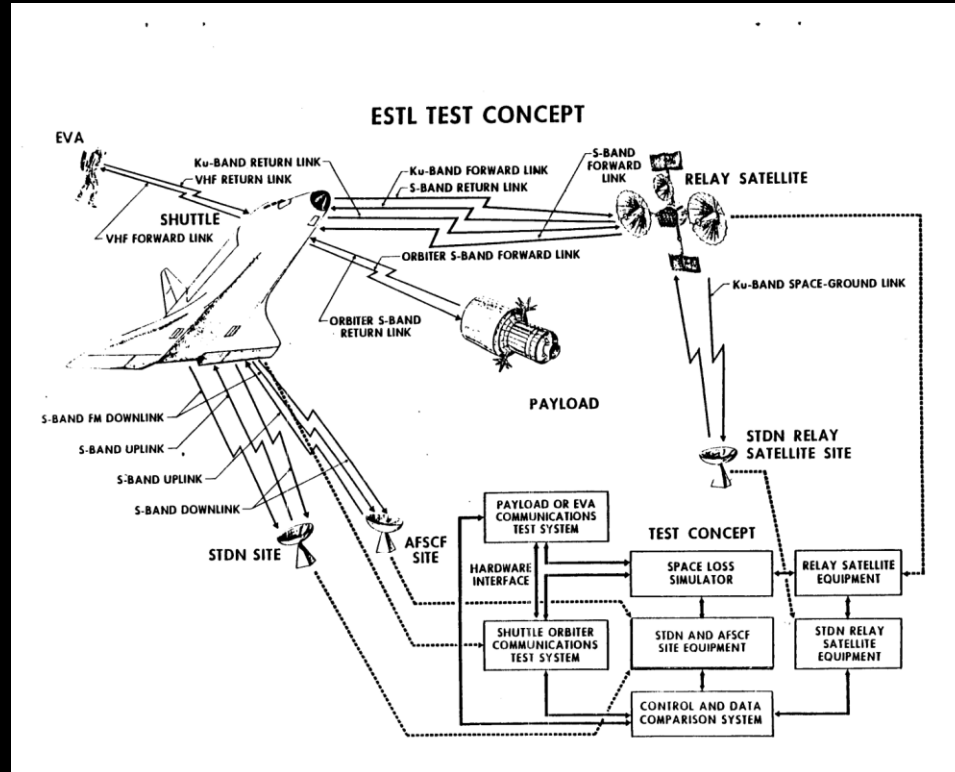
# TDRSS-Tracking and Data Relay Satellite System



Panorama recente(2019) da constelação dos TDRS, que permitem cobertura mundial e transmissão quase contínua de informação sobre as missões correntes.

[1]<https://www.nasa.gov/missions/tdrs/tracking-and-data-relay-satellite-tdrs-fleet-characteristics/>

# Esquema de Funcionamento



[2]Lindsey, William & Chie, Matsukawa & Cideciyan, Roy & Dessouky, Khaled & Su, Yu & Tsang, C.. (1986). Space Shuttle/TDRSS communication and tracking systems analysis.

# Protocolos - Principais no Space Shuttle

## ❖ Protocolo PCM (Pulse Code Modulation)

- ▶ Codifica os Dados Analógicos para Digitais
- ▶ Os satélites enviam os mesmos dados para as Ground Stations

## ❖ Protocolo TDM (Time Division Multiplexing)

- ▶ Permite transmitir múltiplos canais de dados em um único fluxo
- ▶ Reduz o uso de largura de banda e otimiza os recursos

## ❖ Protocolo CCDS (Consultative Committee for Space Data Systems)

- ▶ Protocolo padrão internacional para a troca de dados em missões espaciais
- ▶ Utilizado para compressão, formatação e roteamento dos dados.

# Conclusão

## ❖ Papel Central da Telemetria

- ▶ Foi essencial para o sucesso de missões do Space Shuttle.
- ▶ Garantiu a segurança da tripulação, desempenho da nave e a aquisição de novos dados.

## ❖ Legado

- ▶ O sistema de telemetria do Space Shuttle estabeleceu um padrão para missões espaciais tripuladas.
- ▶ Continua a ser referência para sistemas de telemetria modernos.



## ❖ Integração e Coordenação

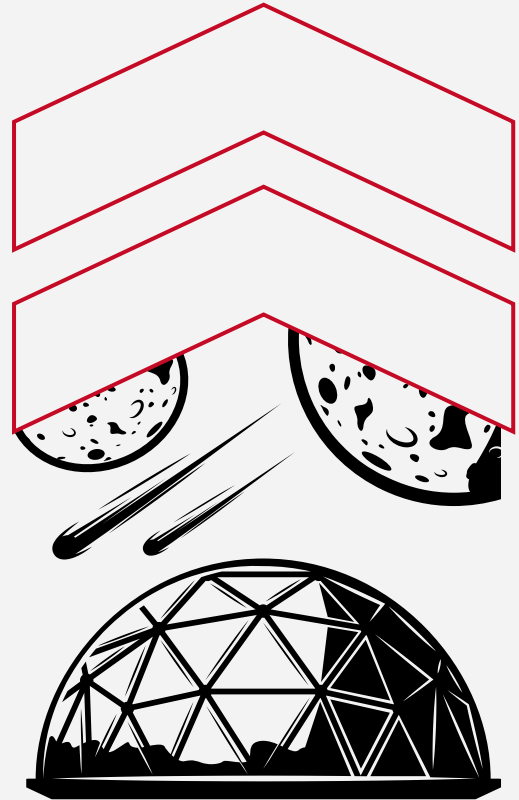
- ▶ A integração de sistemas e subsistemas foi fundamental para as operações.
- ▶ Garantiu uma melhor tomada de decisões, com vista panorama do sistema completo.

# Referências

- ▶ [1] <https://dewesoft.com/blog/nasa-pcm-telemetry-processing-station>
- ▶ [2] <https://www.nasa.gov/missions/tdrs/tracking-and-data-relay-satellite-tdrs-fleet-characteristics/>
- ▶ [3] Lindsey, William & Chie, Matsukawa & Cideciyan, Roy & Dessouky, Khaled & Su, Yu & Tsang, C.. (1986). Space Shuttle/TDRSS communication and tracking systems analysis.
- ▶ <https://www.nasa.gov/mission/tracking-and-data-relay-satellites/>
- ▶ Lindsey et al., 1986 - Análise dos sistemas de comunicação do Space Shuttle/TDRSS
- ▶ Hoagland, A., Publisher, J., & Hoagland, J. (n.d.). SPACE SHUTTLE COMMUNICATIONS AND TELEMETRYAN INTRODUCTION WITH FLIGHT RESULTS Item Type text; Proceedings SPACE SHUTTLE COMMUNICATIONS AND TELEMETRY-AN INTRODUCTION WITH FLIGHT RESULTS.

# INTRODUCTION

You can give a brief description of the topic you want to talk about here. For example, if you want to talk about Mercury, you can say that it's the smallest planet in the entire Solar System







# OUR COMPANY

Do you know what helps you make your point clear? Lists like this one:

- ▶ They're simple
- ▶ You can organize your ideas clearly
- ▶ You'll never forget to buy milk!

And the most important thing: the audience won't miss the point of your presentation

# OUR TEAM



**JOHN JAMES**

You can speak a bit about this  
person here



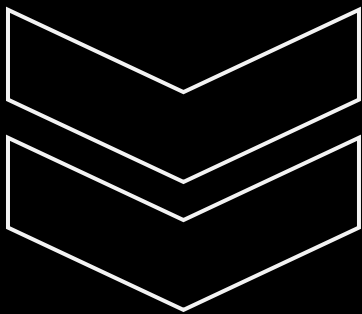
**JENNA DOE**

You can speak a bit about this  
person here



**MARK JAN**

You can speak a bit about this  
person here

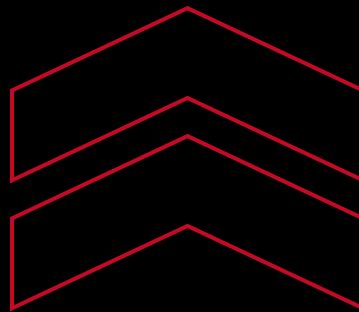


# THEM

Mercury is the closest planet to the Sun and the smallest one in the Solar System—it's only a bit larger than the Moon. The planet's name has nothing to do with the liquid metal, since Mercury was named after the Roman messenger god

# US

Venus has a beautiful name and is the second planet from the Sun. It's terribly hot—even hotter than Mercury—and its atmosphere is extremely poisonous. It's the second-brightest natural object in the night sky after the Moon





## SOLUTION

Venus has a beautiful name and is the second planet from the Sun. It's terribly hot, even hotter than Mercury, and its atmosphere is extremely poisonous. It's the second-brightest natural object in the night sky after the Moon

# SWOT ANALYSIS



## STRENGTHS

Mars is actually a very cold place



## WEAKNESSES

Venus has extremely high temperatures



## OPPORTUNITIES

Jupiter is the biggest planet of them all



## THREATS

Saturn is a gas giant and has rings



# PRODUCT OVERVIEW



## MARS

Mars is actually a very cold place



## VENUS

Venus has extremely high temperatures



## NEPTUNE

Neptune is the farthest planet from the Sun



## MERCURY

Mercury is the closest planet to the Sun



## SATURN

Saturn is a gas giant with several rings



## JUPITER

Jupiter is the biggest planet of them all

# OUR PLANS



**BASIC**

**\$2500**

Saturn is a gas giant, composed mostly of hydrogen and helium



**PRO**

**\$5000**

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



**PREMIUM**

**\$7500**

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

# PRODUCT DEMO

You can replace the image on the screen with your own work. Just right-click on it and select "Replace image"

0013



Insert your multimedia content here



# TRACTION



## MARS

Mars is actually  
a very cold place



## VENUS

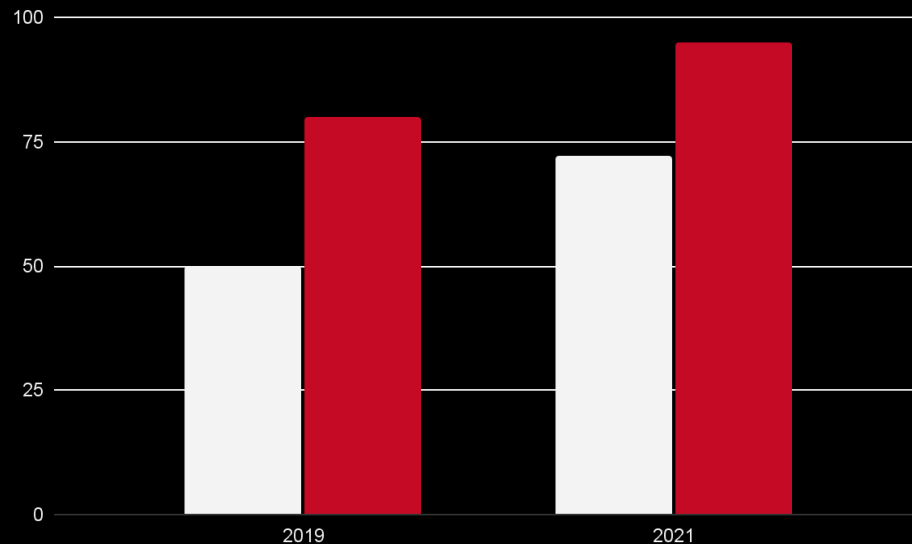
Venus has high  
temperatures

# 1200

Satellites

# 5000

Solutions



Follow the link in the graph to modify its data and then  
paste the new one here. **For more info, click here**

# CASE STUDY



## CHALLENGE

Venus has extremely high temperatures



## RESULTS

Saturn is composed mostly of hydrogen and helium



## SOLUTION

Jupiter is the biggest planet in the Solar System

# REVIEWS

0016



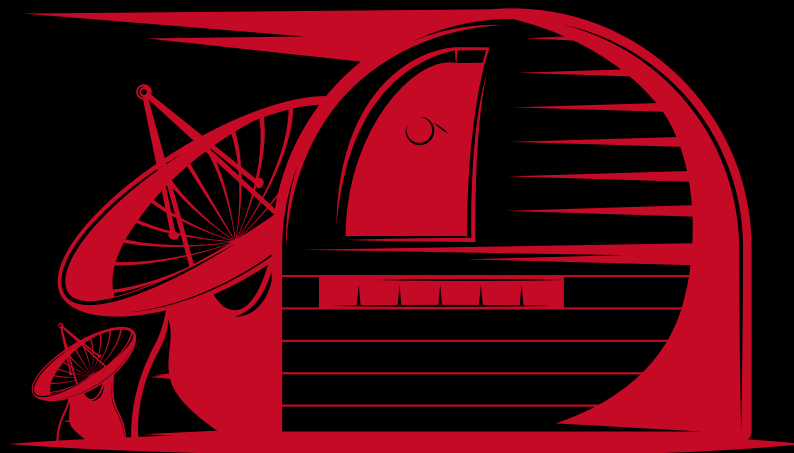
"Jupiter is the biggest planet in the Solar System"

**JOHN DOE**



"Venus has a beautiful name, but also high temperatures"

**JEN JAMES**



# AWARDS

00017

## MERCURY

Mercury is the smallest planet of them all



## MARS

Mars is actually a very cold place



## VENUS

Venus is the second planet from the Sun



## JUPITER

Jupiter doesn't have a solid surface



# MARKET SIZE

30%



## VENUS

Venus has extremely high temperatures

20%



## NEPTUNE

Neptune is the farthest planet from the Sun

50%



## JUPITER

Jupiter is the biggest planet of them all

# TARGET

## GENDER

40%  
Male

50%  
Female

10%  
Others

## AGE



75%  
25-40

## PROFESSIONS



Engineer



Analyst



Administrator

## INVESTMENT:

\$100,000

Per mission participant

0019

# COMPETITORS



## VENUS

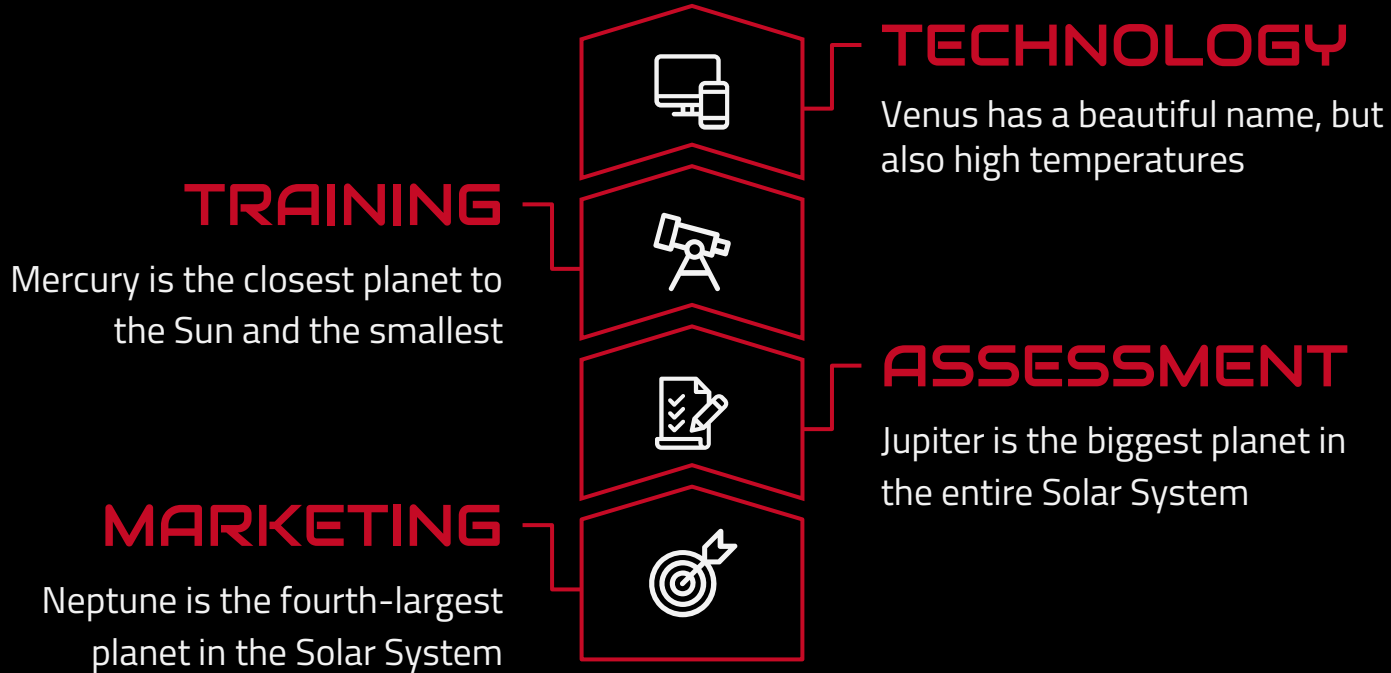
Venus is the second planet from the Sun



## MERCURY

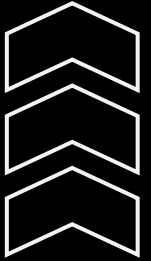
Mercury is the closest planet to the Sun

# BUSINESS MODEL





# TIMING



Venus is the second planet from the Sun

**DAY 1**

**DAY 2**

Mercury is the closest planet to the Sun

Despite being red, Mars is a very cold place

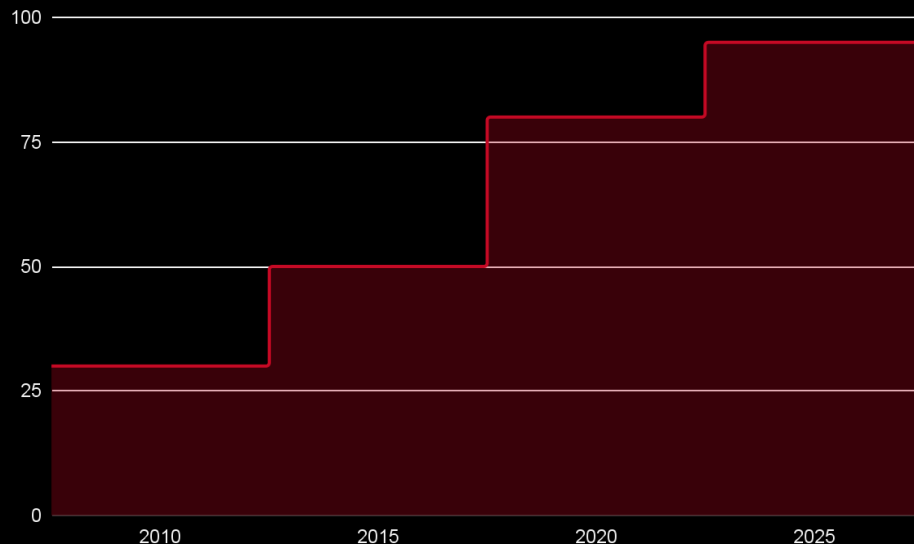
**DAY 3**

Jupiter is the biggest planet of them all

**DAY 4**



# PREDICTED GROWTH



**\$900,000**

Expected for 2025

**100**

Participants

Follow the link in the graph to modify its data and then paste the new one here. **For more info, click here**

# INVESTMENT

	2020	2021	2022
JUPITER	\$100,500	\$200,000	\$500,000
VENUS	\$50,000	\$150,000	\$250,000
MERCURY	\$76,200	\$92,000	\$100,000
NEPTUNE	\$35,000	\$50,000	\$75,000



# AWESOME WORDS

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

**—SOMEONE FAMOUS**



0027

A black and white photograph of an astronaut in a full spacesuit crouching on a dark, rocky, and dusty planet surface. The astronaut is holding a camera or a similar device. In the background, there are large, jagged rock formations and a small, white, six-wheeled rover with two figures standing nearby. The scene is set against a hazy, overcast sky.

A PICTURE IS WORTH A  
THOUSAND WORDS

# A PICTURE ALWAYS REINFORCES THE CONCEPT

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



# 498,300

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



# THANKS!

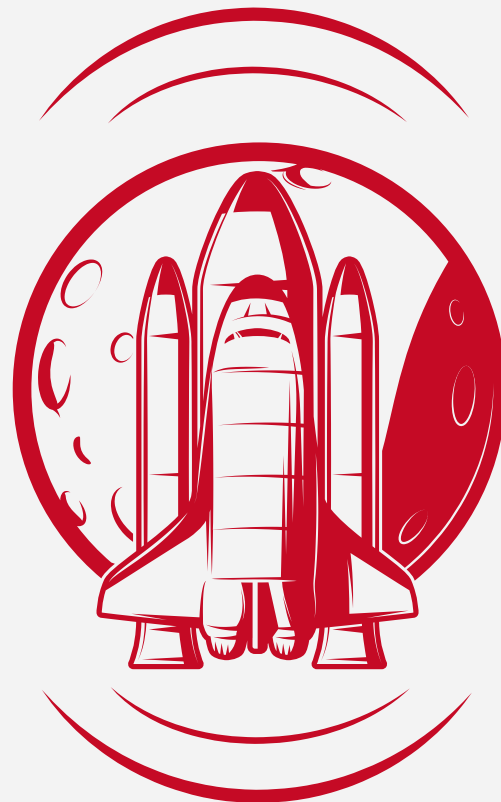
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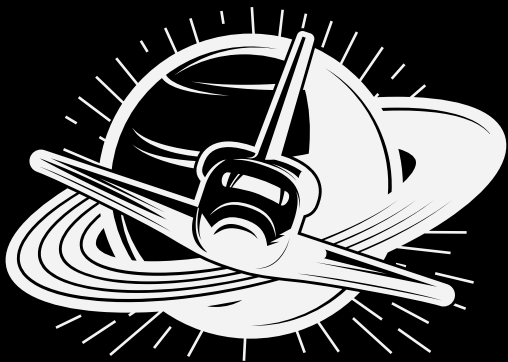
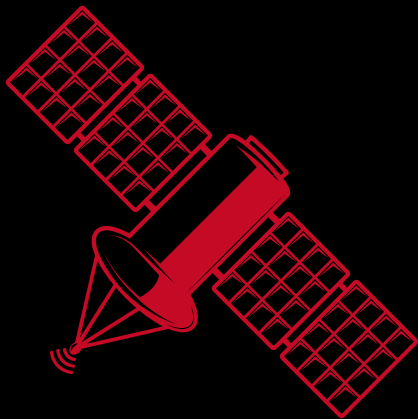


0001

# ALTERNATIVE RESOURCES

Here's an assortment of alternative resources whose style fits that of this template:

- ▶ Space black white emblems of journeys and academies with astronaut shuttle scientific equipment isolated
- ▶ Space monochrome elements set with astronaut shuttles and rockets cosmic objects observatory and radar isolated



# RESOURCES

Did you like the resources on this template? Get them for free at our other websites:

## VECTORS

- ▶ Space black white emblems of journeys and academies with astronaut shuttle scientific equipment isolated
- ▶ Space monochrome elements set with astronaut shuttles and rockets cosmic objects observatory and radar isolated
- ▶ Vintage monochrome space labels set with spaceships ufo astronauts rocket antenna helmet scientific station comets

## PHOTOS

- ▶ Handsome adult male posing
- ▶ Young adult pressing buzzer button I
- ▶ Young adult pressing buzzer button
- ▶ Creative collage of mars planet with astronaut I
- ▶ Creative collage of mars planet with astronaut II

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(<https://fonts.google.com/specimen/Audiowide>)

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(<https://fonts.google.com/specimen/Titillium+Web>)

A red rounded square containing the hex code #c50a25.

#c50a25

A black rounded square containing the hex code #000000.

#000000

A light gray rounded square containing the hex code #f3f3f3.

#f3f3f3

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Pana



Amico



Bro



Rafiki



Cuate

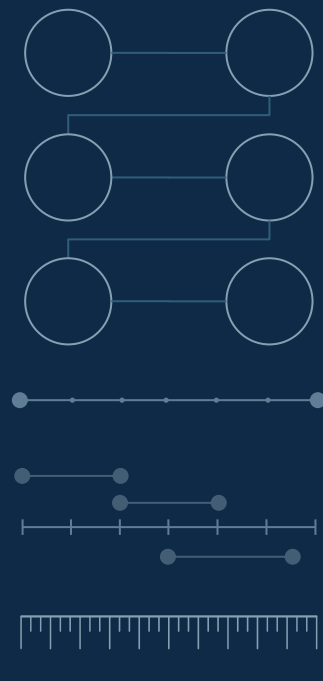
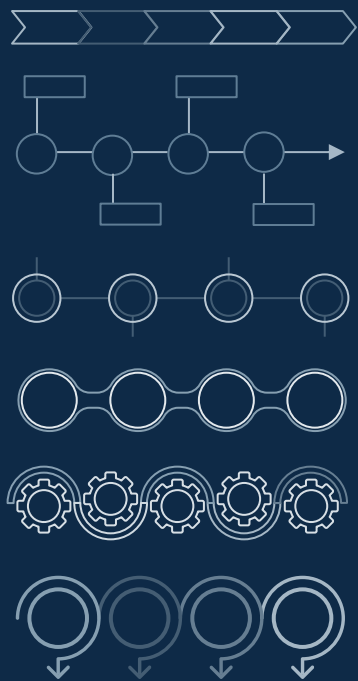
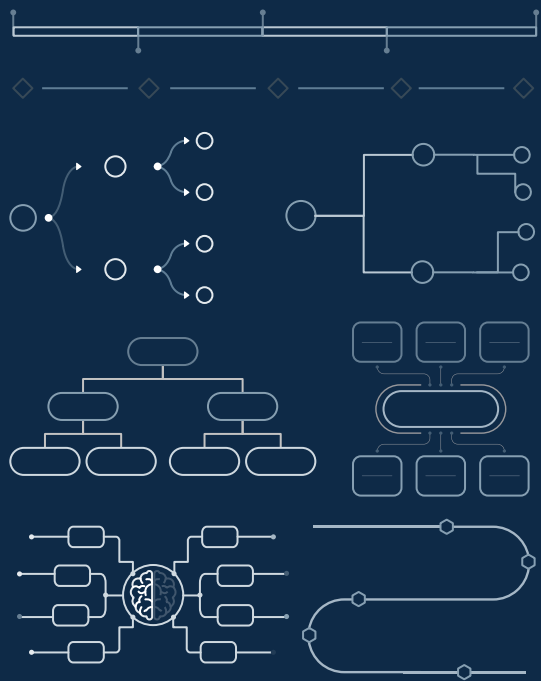


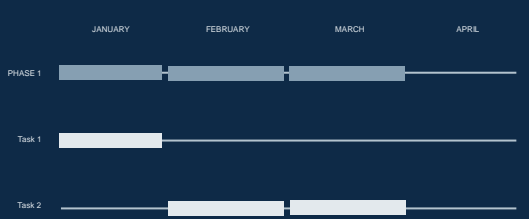
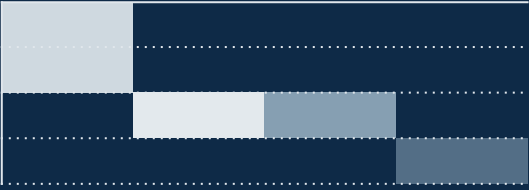
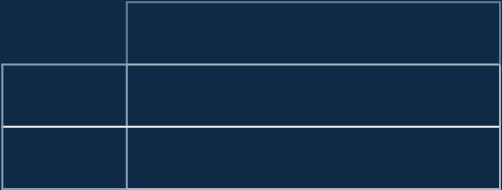
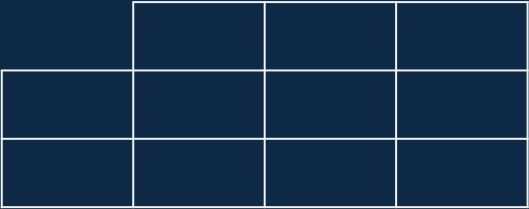
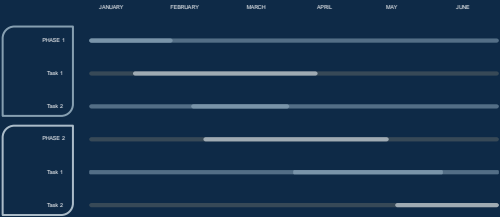
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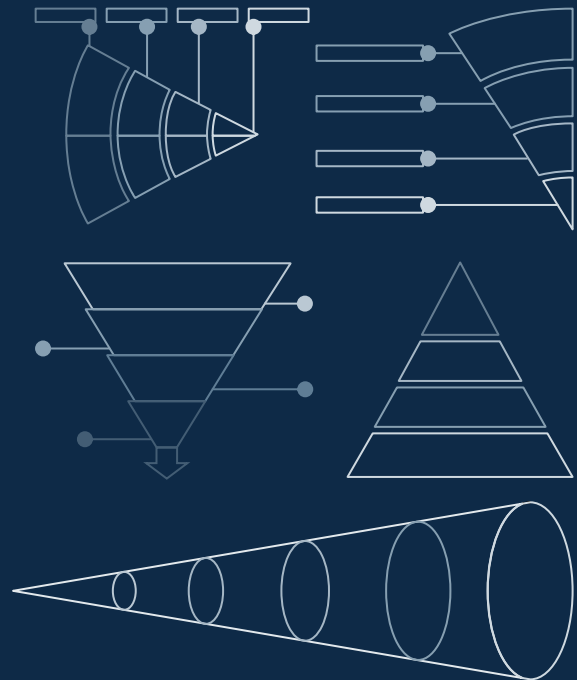
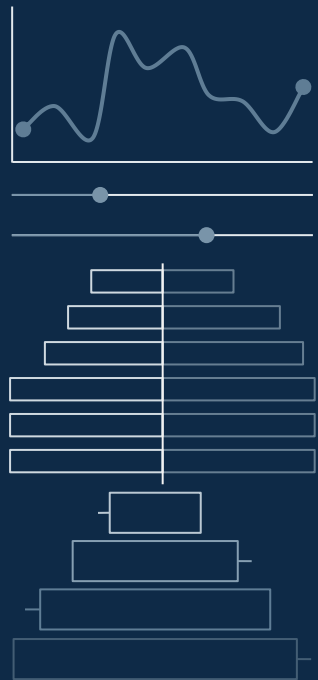
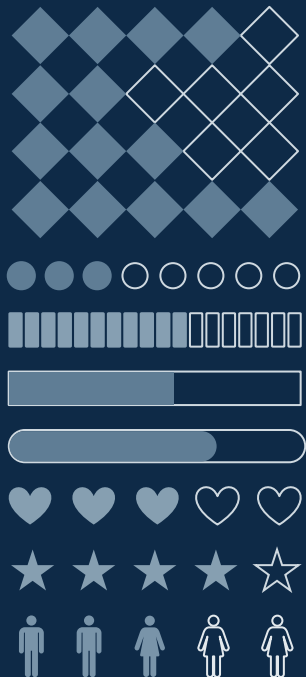
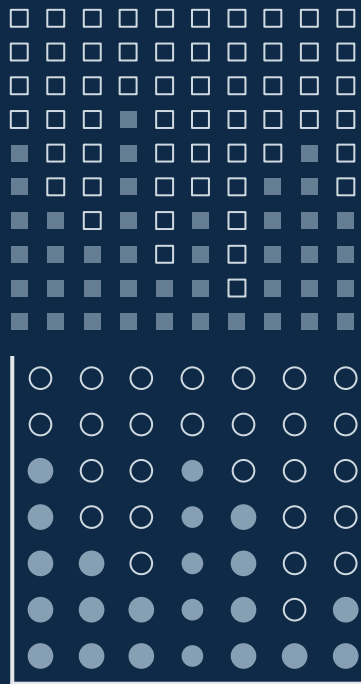












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