Pure Water for Laboratory

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Why Water Quality Matters

Many impurities can be present in water, which may interfere with testing and lead to inaccurate results

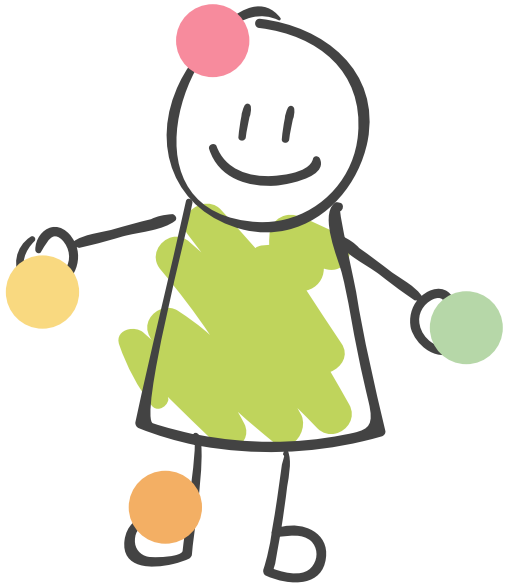
- Examples: Effects on chemical reactions, cell culture, analytical techniques

Water Purity Classes

- Laboratory water is classified based on purity levels: Type I, II, III
- Each type serves different purposes depending on purity requirements

Water Purity Classes

- Type I Water: Ultrapure Water
- Type II Water: Pure Water
- Type III Water: General Laboratory Water



Type I Water: Ultrapure Water

Highest Purity:

- Having the highest level of purity
- Extremely low levels of ions, organics, particulates, bacteria, and pyrogens.

Resistivity

- ≥ 18.2 megohms-cm (MΩ·cm) at 25°C, indicating very low ionic content

Total Organic Carbon (TOC)

- Less than 5 parts per billion (ppb), signifying minimal organic contamination

Bacteria and Particulate Content

- Virtually free of bacteria and particulates, making it suitable for highly sensitive experiments

Production Methods of Type I Water

Step 1

Reverse Osmosis (RO):
Initial purification step to remove most dissolved solids, organic molecules,

Step 2

Deionization (DI):
Use ion exchange resins to remove cations and anions
Low conductivity

Step 3

Ultrafiltration :
Removes particulates and pyrogens

Step 4

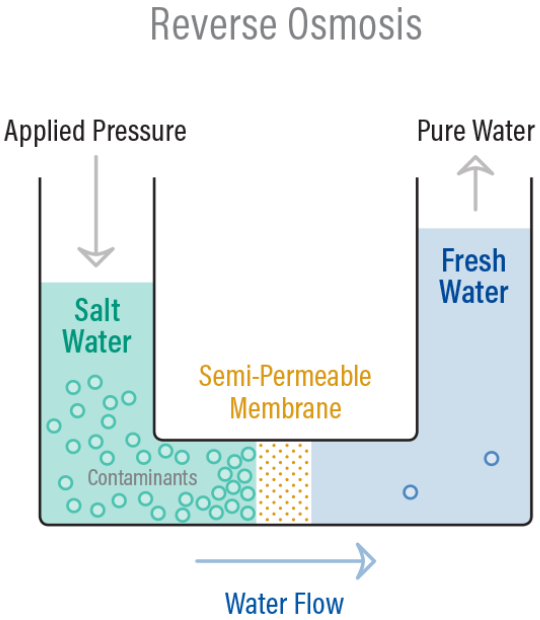
UV Oxidation:
Ultraviolet (UV) treatment at 185 nm and 254 nm to degrade and oxidize organic contaminants

Step 5

Final Filtration:
A 0.2-micron filter or finer is used to remove any remaining particulates and bacteria

Step 1 : Reverse Osmosis

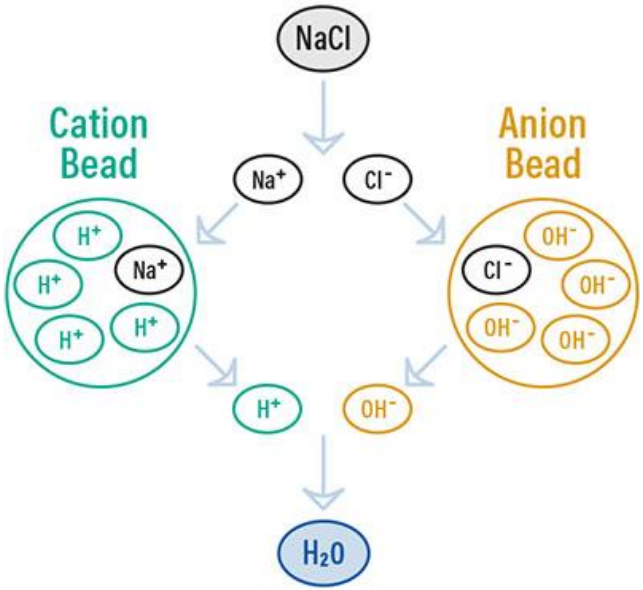
เป็นกระบวนการที่เกิดขึ้นเมื่อเราใส่ความดันให้กับฝั่งที่มีความเข้มข้นของสารละลายสูง จนความดันน้ำสูงกว่าความดันออสโมติก(Osmotic Pressure)โดยโมเลกุลของเหลวหรือน้ำจะถูกบีบให้ผ่าน เยื่อเมมเบรน (Membrane)จากบริเวณที่มีความเข้มข้นของสารละลายสูง ไปยังบริเวณที่มีความเข้มข้นของสารละลายต่ำ



Step 2 : DI (Deionized water)

น้ำ DI (Deionized Water) คือ การทำน้ำให้มีความบริสุทธิ์สูงมาก โดยผ่าน Ion Exchange เพื่อจับทั้งไอออนบวกและลบออกจากน้ำ

โดยกระบวนการของน้ำ DI มักจะต้องใช้ระบบ RO เพื่อทำให้น้ำบริสุทธิ์ในระดับนึงก่อน แล้วจึงใช้ Ion Exchange จับประจุทั้งบวกและลบอีกครั้ง เพื่อให้น้ำปราศจากแร่ธาตุและสิ่งเจือปนให้ได้มากที่สุดก่อนนำไปใช้งาน



Applications

- Type I water is essential for applications requiring the utmost purity

  - High-Performance Liquid Chromatography (HPLC)
  - Gas Chromatography-Mass Spectrometry (GC-MS)
  - Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
  - Molecular Biology (e.g., PCR, DNA sequencing) Cell Culture

Type II Water: Pure Water

Intermediate Purity

- Suitable for many general laboratory applications

Resistivity

Resistivity of 1-10 MΩ·cm at 25°C , Sufficient for routine analytical procedures

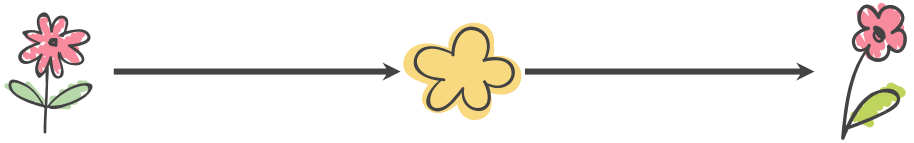
Total Organic Carbon (TOC)

Below 50 ppb

Bacteria and Particulate Content

- Contains more bacteria and particulates than Type I water

Production Methods of Type II Water



Step 1

Reverse Osmosis (RO):
Removes dissolved salts and organic molecules

Step 2

Deionization (DI):
Removes most cations and anions

Step 3

UV Treatment:
Reduces organic contaminants and controls microbial content

Applications

- Type II water is used in applications that require pure water but do not demand the extreme purity of Type I water, such as:

  - Buffer Preparation
  - pH Solution Preparation
  - General Chemistry Reactions
  - Microbiological Media Preparation
  - Clinical Analyzer Feed Water

Type III Water: General Laboratory Water

Basic Purity

- the lowest purity among the three types and is intended for non-critical laboratory tasks

Resistivity

Typically has a resistivity of 0.05–1 MΩ·cm at 25°C, reflecting higher levels of ionic and particulate contaminants compared to Types I and II.

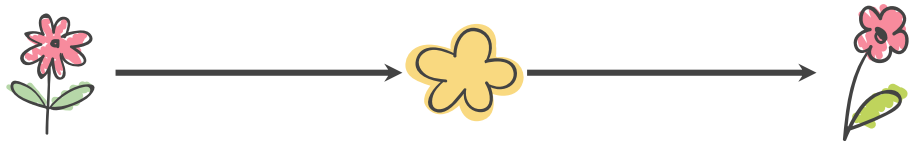
Total Organic Carbon (TOC)

Higher TOC levels are acceptable, making this water type suitable for less sensitive applications

Bacteria and Particulate Content

- Higher bacterial and particulate content is permissible

Production Methods of Type III Water



Step 1

Filtration: Removes large particulates and some microbial content

Step 2

Reverse Osmosis (RO): Single-pass treatment reduces contaminants

Step 3

Carbon Filtration: Removes chlorine and organic compounds

Applications

- Type III water is generally used for laboratory tasks that do not require high purity, such as:

  - Glassware Washing
  - Autoclave Feed Water
  - Heating Baths
  - Rinsing and General Cleaning
  - Non-critical Reagent Preparation

Quality Standards and Regulations

ASTM:

American Society for Testing and Materials

ISO:

International Organization for Standardization

CLSI:

Clinical and Laboratory Standards Institute

Monitoring and Testing Water Quality

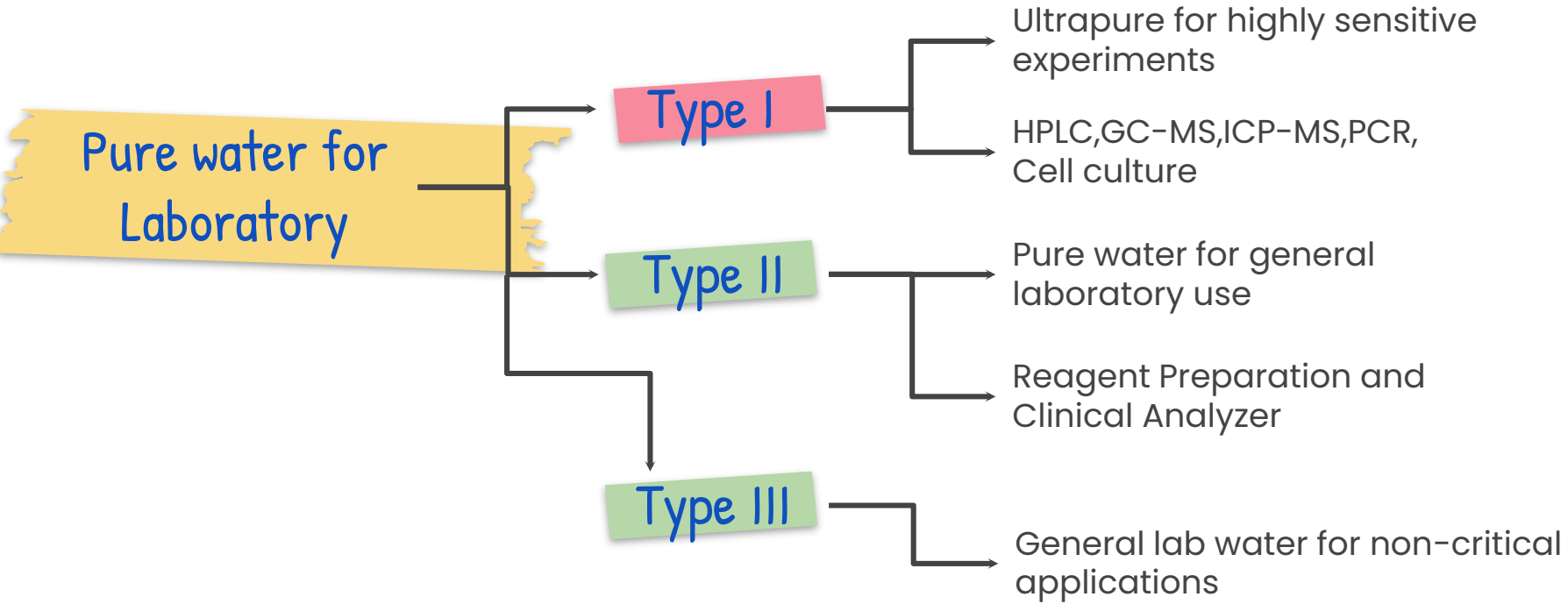
Methods

- Conductivity
- resistivity
- TOC Testing
- Microbial testing

Importance

- Regular testing to maintain standards

Summary of Water Types and Their Uses



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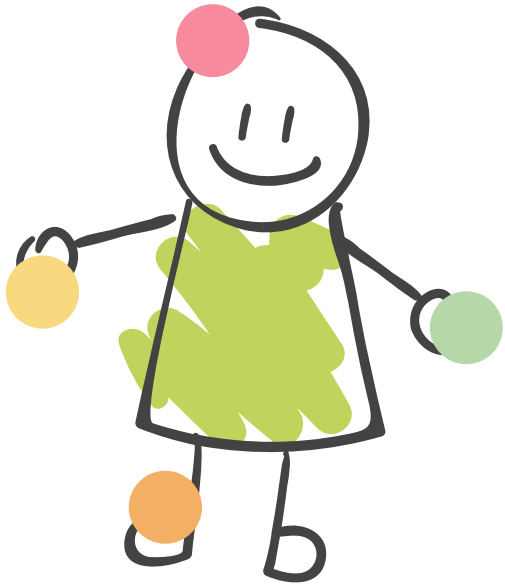

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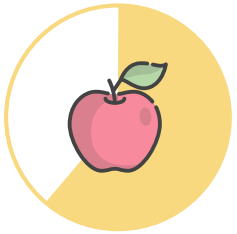
75%

Mercury

It’s the closest to the Sun

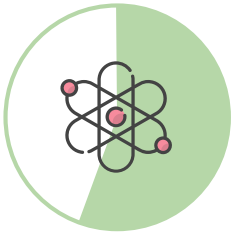
60%



Saturn

It’s a gas giant with many rings

55%



Mars

It’s actually a very cold place

40%

Jupiter

It’s a gas giant and it’s very big

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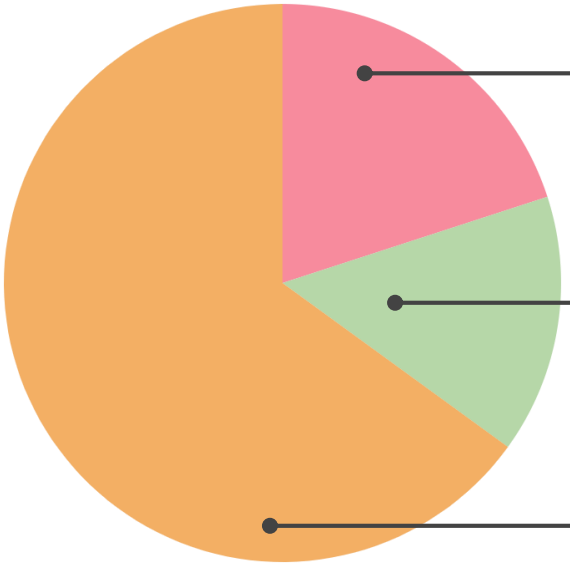

20%

Venus

It’s the biggest planet in the System

15%

Mercury

It’s the closest planet to the Sun

65%

Jupiter

It’s the biggest planet in the System

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

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Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	2	3	4	5	6	7
8	**9**	10	11	12	13	14
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29	30	**31**	1	2	3	4

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21 Mon	22 Tue	23 Wed	24 Thu	25 Fri	26 Sat	27 Sun
Mercury is the closest planet to the Sun	Venus is the second from the Sun	Jupiter is the biggest planet of them all	Mars is red, but it's a very cold place	Saturn is a gas giant and has rings	Neptune is very far away from us	Earth is the planet where we all live on

Notes

Neptune is the farthest planet from the Sun. It's also the fourth-largest object by diameter in the Solar System

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Earth

It’s the third planet from the Sun

01

Neptune

It’s the farthest planet from the Sun

02

Mars

Despite being red, Mars is a cold place

03

Mercury

It’s the closest planet to the Sun

04

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Mercury

It's the closest planet to the Sun

Jupiter

Jupiter is the biggest planet of them all

Venus

It has very high temperatures

Saturn

It's a gas giant with several rings

Mars

Despite being red, Mars is very cold

Earth

The Earth is the planet we live on

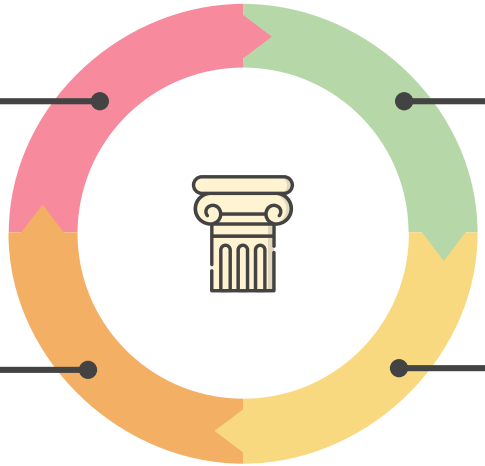
Cute family doodle collage Infographics

Mars

Despite being red, Mars is actually a very cold place

Saturn

Saturn is composed mostly of hydrogen and helium



Jupiter

It's a gas giant and the biggest planet in the Solar System

Mercury

It's the closest planet to the Sun and the smallest one

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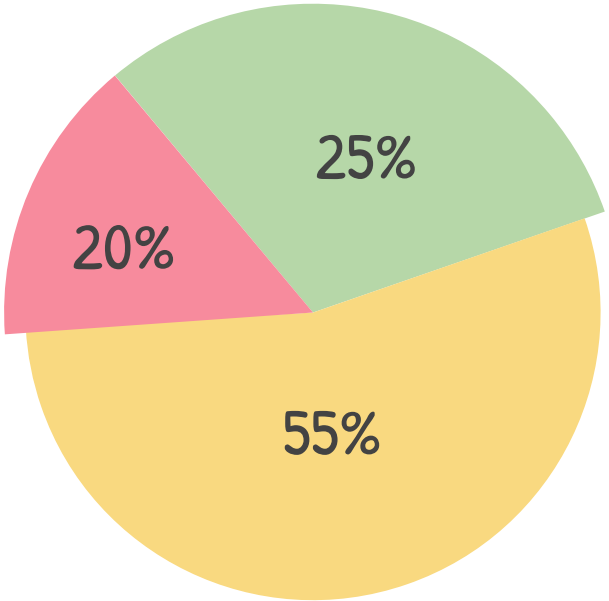

Mercury

Mercury is the closest planet to the Sun

Saturn

Saturn is composed of hydrogen and helium

Neptune

Neptune is the farthest planet from the Sun

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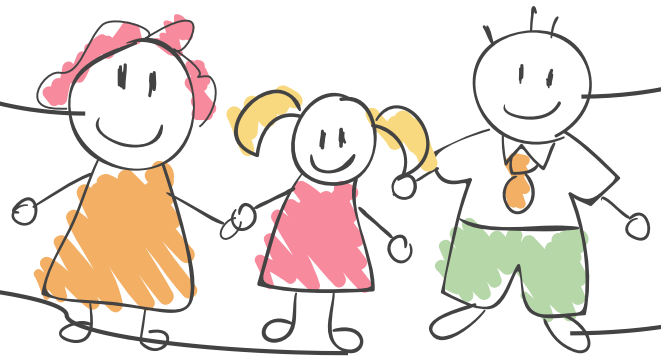
Earth

It's the third planet from the Sun

Neptune

It's the farthest planet from the Sun



Mercury

It's the closest planet to the Sun

Mars

Despite being red, Mars is a cold place

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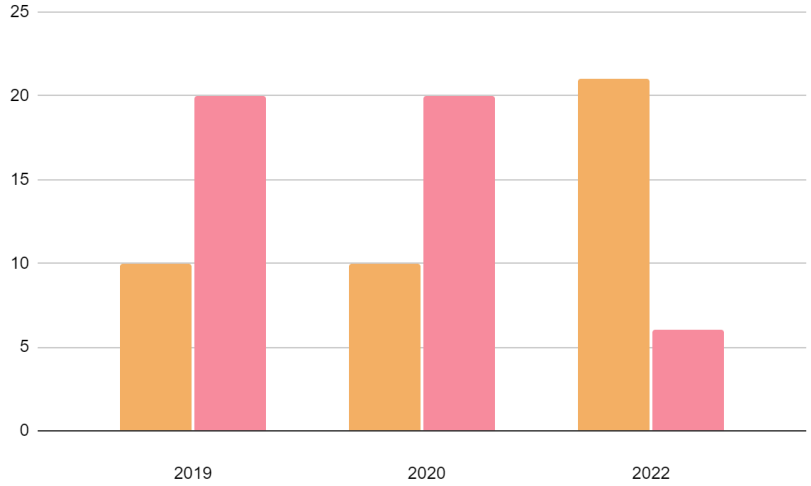

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Jupiter

It's the biggest planet in the Solar System

Mercury

The smallest planet in the Solar System

Cute family doodle collage Infographics

Venus

Venus is the second planet from the Sun

Earth

This is the place where we all live on

Saturn

Saturn is composed of hydrogen and helium

Mercury

Mercury is the closest planet to the Sun

Jupiter

Jupiter is the biggest planet of them all

Mars

Despite being red, Mars is actually a very cold place

Cute family doodle collage Infographics

16,000

Mars

Despite being red,
Mars is a cold place

80,000

Mercury

It’s the closest
planet to the Sun

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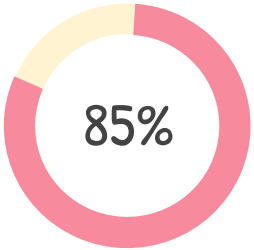
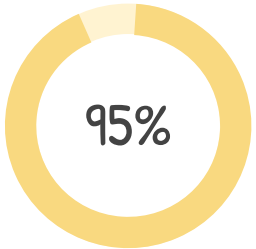


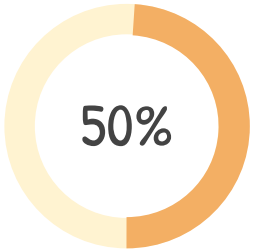
Saturn

Saturn has several rings



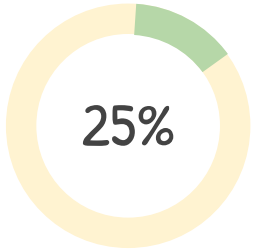
Mercury

Mercury is a very small planet



Earth

The only planet with life



Mars

Mars is a very cold place

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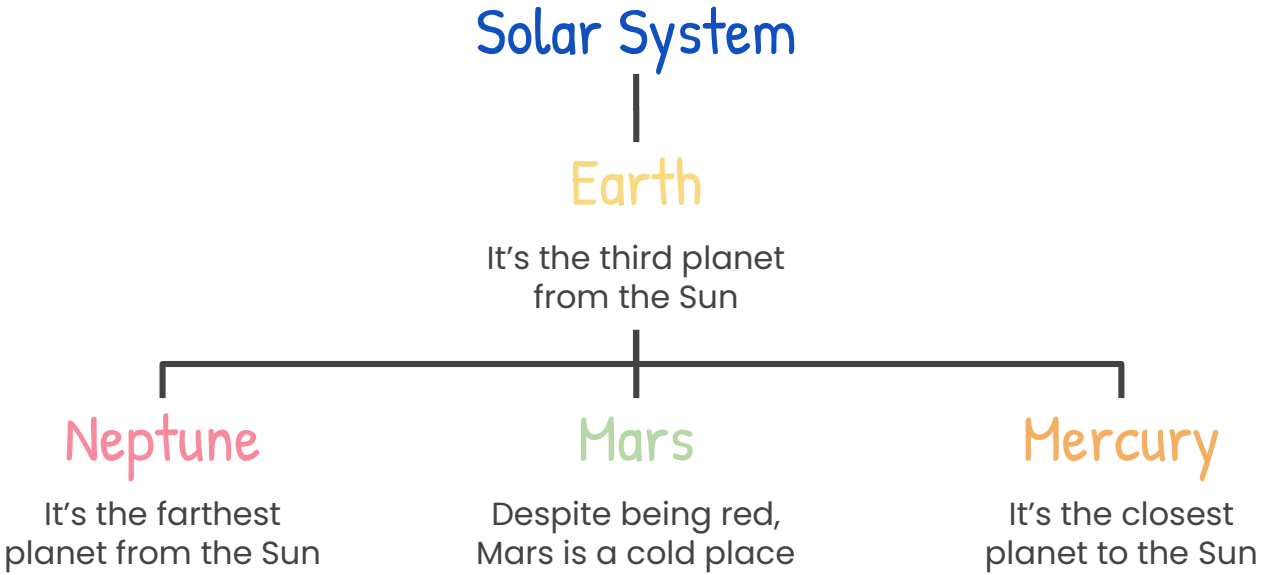

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Mars	Venus	Earth	Neptune
			
Mars is actually a very cold place full of iron oxide dust	Venus is the second planet from the Sun	Earth is the third planet and the one where we live on	Neptune is the farthest planet from the Sun

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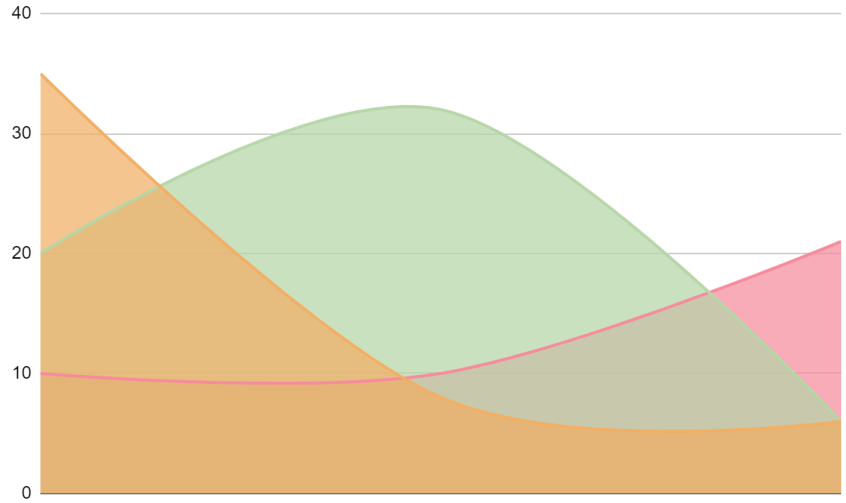

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Jupiter

It's the biggest planet in the Solar System

Mercury

It's the smallest planet in the Solar System

Saturn

It's composed mostly of hydrogen and helium

Cute family doodle collage Infographics

Saturn

It’s the only ringed planet

Mercury

It’s the closest to the Sun

Mars

It's actually a very cold place

Jupiter

Jupiter is a very big planet

Cute family doodle collage Infographics

Mercury

The closest to the Sun

Mars

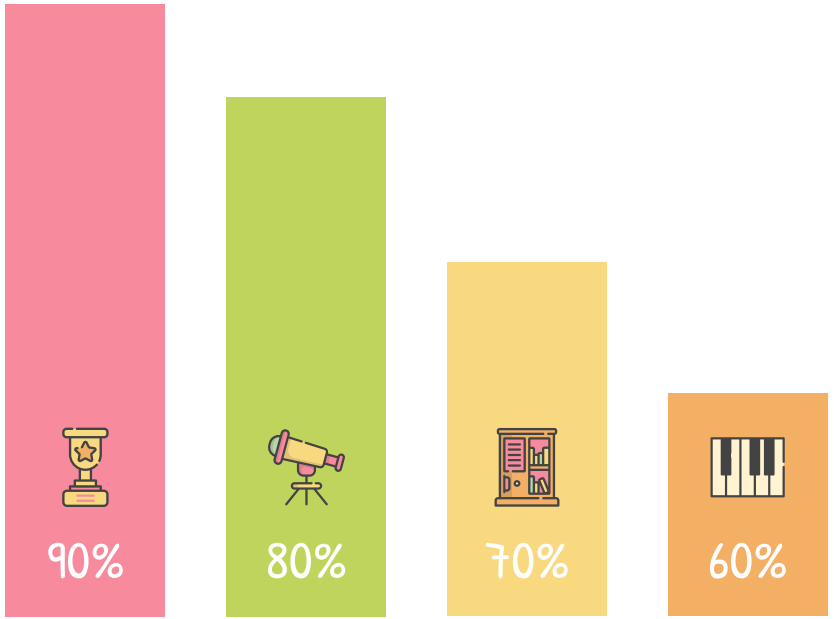
A very cold place

Saturn

A ringed planet

Earth

The only planet with life



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Mercury

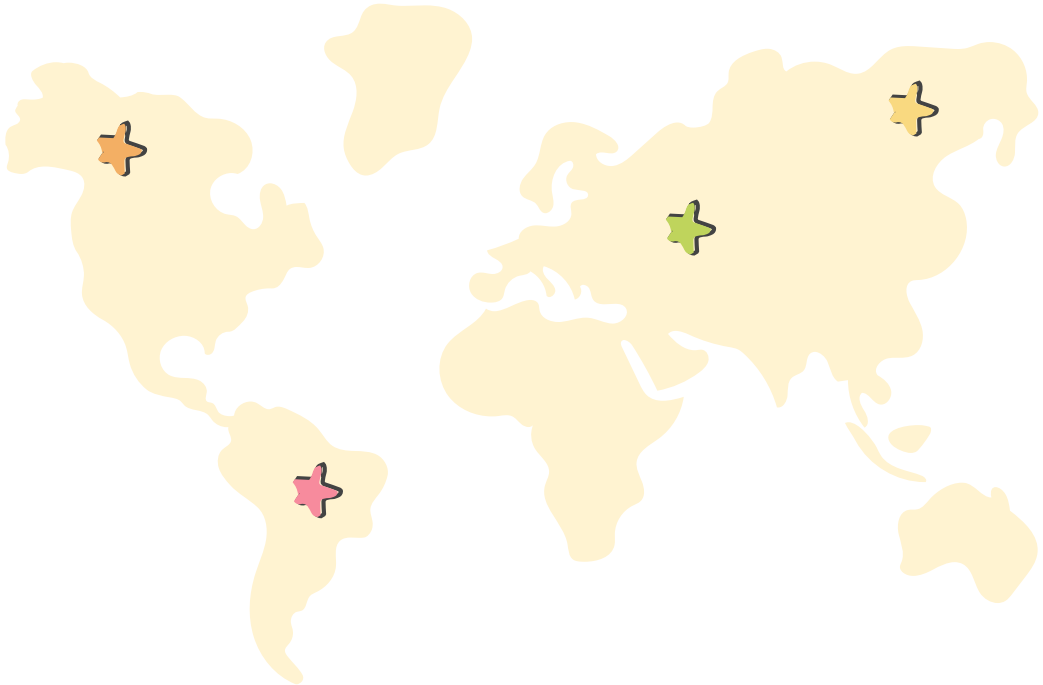
It’s the closest to the Sun

Mars

Mars is actually a cold place

Jupiter

Jupiter is a very big planet



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	Monday	Tuesday	Wednesday	Thursday	Friday
Week 1	✓				✓
Week 2		✓	✓		
Week 3	✓			✓	
Week 4			✓		

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Saturn

Saturn is a gas giant and it has several rings

25%

Jupiter

Jupiter is the biggest planet in the Solar System

50%

Mercury

Mercury is the smallest planet in the Solar System

75%

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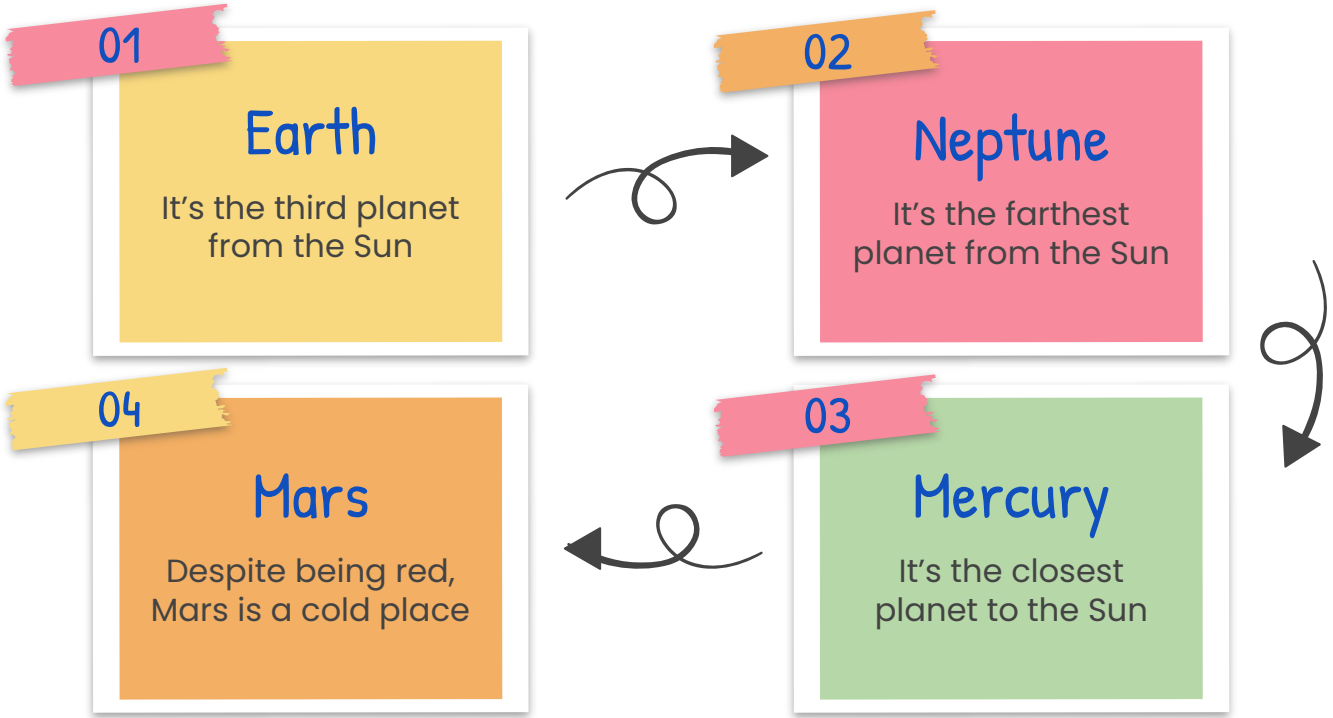

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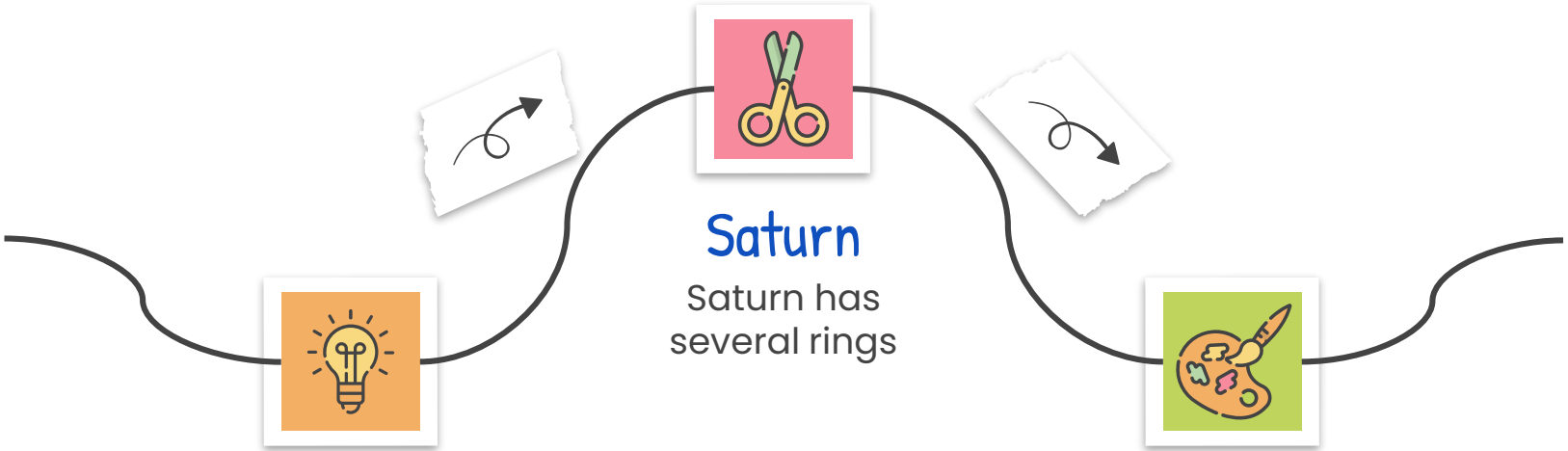

Saturn

Saturn has several rings

Earth

The only planet with life

Mercury

Mercury is a very big planet

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- Then **resize** the element by clicking and dragging one of the square-shaped points of its bounding box (the cursor should look like a double-headed arrow). Remember to hold Shift while dragging to keep the proportions.
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