

# Planets Science Series:

Water in the Solar System

PLANETARY CARDS



## PLANETS Cards

PLANETS (Planetary Learning that Advances the Nexus of Engineering Technology and Science) is a NASA-funded education project that aims to develop and disseminate out-of-school time curricular and related educator professional development modules that integrate planetary science, technology, and engineering. These cards are part of an activity in our Science Series: *Water in the Solar System*.



This material is based upon work supported by NASA under cooperative agreement award number NNX16AC53A. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration (NASA).

Partner **PLANETS** v 2.0

### Games

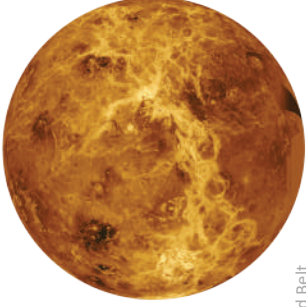
**Build the Solar System** (2-5 players). Shuffle all cards randomly. Deal 6 cards to each player, leaving a draw pile. The first card played must be a planet or dwarf planet. Using the solar system location information on the card fronts, the next player must build on this card by playing (1) an adjacent planet - to the right or left, (2) a moon of the planet - below, or (3) another card of the same planet - on top. A planet must be played before a moon of that planet can be played. Asteroids are played as planets (i.e., Jupiter cannot be played next to Mars). A player who can't play draws one card from the pile. If the drawn card plays they may play it, otherwise they are skipped, or are skipped if there are no more cards in the draw pile. The object is to be the first to play all their cards. To play several rounds, one may keep score with the water droplet values - whoever has the least water wins.


**Accretion** (2-5 players). Like the card game war or battle, the objective is to win all the cards. Alternatively, the player who collects most of the water in the solar system could be declared the winner. Shuffle all cards randomly. Deal all cards evenly among all players. In unison, each player reveals the top card of their deck, front up. Using the information on the card fronts, the player with the highest gravity value takes all the cards played and moves them to their deck. If two cards played have equal gravity values, then there is a battle. Battling players place the next card of their deck front down and then another card front up. The owner of the higher front up card wins the battle and adds all cards to their deck.

v 2.0


# Venus

The second planet from the Sun







0.90g  
Gravity




5.243  
Density



Rock




6052  
Radius




IAU SAU 10 AU 20 AU 30 AU 40 AU


# Moon

Earth's moon







0.17g  
Gravity



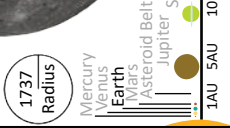
3.344  
Density



Rock



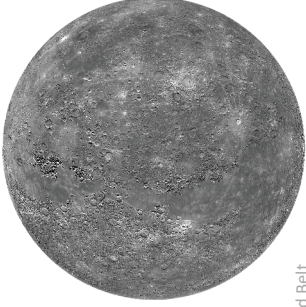
1737  
Radius




IAU SAU 10 AU 20 AU 30 AU 40 AU


# Mercury

The first planet from the Sun







0.38g  
Gravity



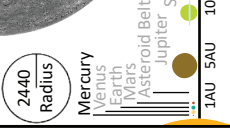
5.427  
Density



Rock



2440  
Radius



IAU SAU 10 AU 20 AU 30 AU 40 AU

# Earth

The third planet from the Sun






1.00g  
Gravity



5.514  
Density



Rock




6371  
Radius




IAU SAU 10 AU 20 AU 30 AU 40 AU


# Earth

The third planet from the Sun







1.00g  
Gravity




5.514  
Density



Rock



6371  
Radius



IAU SAU 10 AU 20 AU 30 AU 40 AU


# Earth

The third planet from the Sun






1.00g  
Gravity



5.514  
Density



Rock



6371  
Radius



IAU SAU 10 AU 20 AU 30 AU 40 AU

## ATMOSPHERE

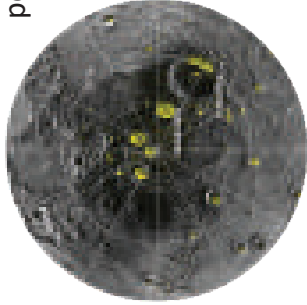
The atmosphere of Venus consists of 0.002% water vapor.



Venus' atmosphere observed from the Pioneer Venus orbiter.

## SURFACE

Water ice is present on Mercury in permanently shadowed craters near the poles.



Yellow areas, mapped using radar, represent polar deposits that might contain pockets of water ice.

## Games (continued)

**Crazy Earths** (2-5 players). Similar to the game Crazy Eights, the object of the game is to be the first player to get rid of all their cards. Shuffle all cards randomly. Deal 6 cards to each player, leaving a draw pile. The top card from the pile is then played to start the game. Players discard by matching "suits" with the top card. Unlike with regular cards, this game uses information that is on both sides of the cards. The "suits" are water reservoir (surface, subsurface, atmosphere, or rings), composition (rock, ice, gas, gas-ice, or rock-ice), and solar system location (Mercury, Venus, Earth, Mars, Asteroid Belt, Jupiter, Saturn, Uranus, Neptune, or Pluto). One can play any Earth card at any time as a wild card. When a player plays an Earth, they declare the "suit" that the next player must play. For example, say "atmosphere" and the next player has to play an atmosphere card; or say "Saturn" and the next player must play a planet or a moon from Saturn's location in the solar system; or say "rock" and the next player must play a planetary body that is a rock type. If a player is unable to match the "suit" of the top card of the discard pile and does not have an Earth, they draw a card from the draw pile. If it plays, they can play it, otherwise their turn is skipped.

**Be Creative.** Try to come up with your own games, or try using them as flash cards to study and learn the characteristics of different planetary bodies. And have fun!

**Want More Information?** Visit <https://planets-stem.org>

v 2.0

## About the Cards

There are 54 cards (not including the introduction cards). For some planetary bodies there are multiple cards - representing different water reservoirs.

**On the front:** The number in the falling apple icon is the surface gravity relative to Earth's (1 g = Earth's surface gravity). The number in the weight icon with the symbol "r" is the average density of the body, in g/cm<sup>3</sup> (the density of water is 1 g/cm<sup>3</sup>). The icons (Rock, Ice, Gas) indicate what the body is mostly made of. The number in the circle icon is the radius of the body (in km). The scale model indicates the location of the planetary body in the solar system. 1 AU (Astronomical Unit) = the average Earth-Sun distance.

**On the back:** The number in the water droplet icon indicates the amount of water in each reservoir on each planetary body. The numbers range from 0 to 285. The water droplet values are mathematically related to the estimated volume of water on each planetary body. To learn more about the water droplet values and how they can be used to calculate the estimated amount of water on each body, please visit our website: <https://planets-stem.org>

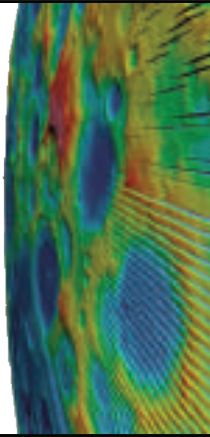
v 2.0

46

4

## SURFACE

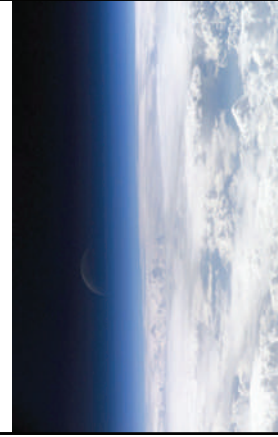
Earth's Moon has small amounts of water frozen in permanently shadowed craters.



Topographic image of Moon's South Pole, from the Lunar Reconnaissance Orbiter mission, shows craters that are never exposed to sunlight.

## ATMOSPHERE

On average, Earth's atmosphere contains 0.4% water vapor.



Earth's atmosphere observed from the International Space Station.

## SURFACE

Surface water is present on Earth in the form of oceans, lakes, rivers, ice caps, and glaciers.



True color mosaic of the Earth, based on images from the Moderate Resolution Imaging Spectroradiometer.

## SUBSURFACE

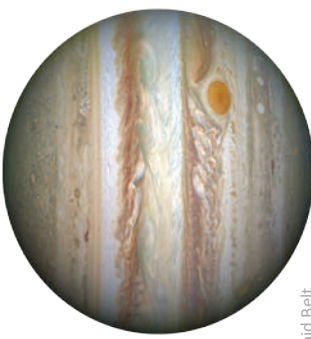
On Earth, water is held underground as liquid water and ice, also known as groundwater and ground ice.



Groundwater exposed by digging a hole in the sand.

# Jupiter


The fifth planet from the Sun



Gravity: 2.53 g  
 Density: 1.326  
 Gas  
 Radius: 69911  
 Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
 TAU SAU 10AU 20AU 30AU 40AU

# Ganymede


The largest moon of Jupiter



Gravity: 0.15 g  
 Density: 1.936  
 Rock Ice  
 Radius: 2634  
 Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
 TAU SAU 10AU 20AU 30AU 40AU

# Mars


The fourth planet from the Sun



Gravity: 0.38 g  
 Density: 3.934  
 Rock  
 Radius: 3390  
 Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
 TAU SAU 10AU 20AU 30AU 40AU

# Ganymede

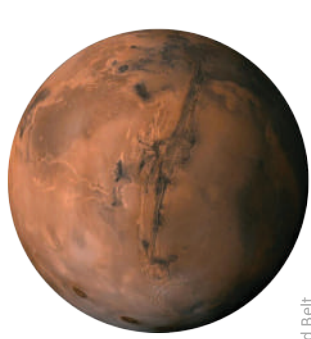
The largest moon of Jupiter



Gravity: 0.15 g  
 Density: 1.936  
 Rock Ice  
 Radius: 2634  
 Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
 TAU SAU 10AU 20AU 30AU 40AU

# Mars


The fourth planet from the Sun



Gravity: 0.38 g  
 Density: 3.934  
 Rock  
 Radius: 3390  
 Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
 TAU SAU 10AU 20AU 30AU 40AU

# Vesta


The second largest object in the Main Asteroid Belt



Gravity: 0.03 g  
 Density: 3.456  
 Rock  
 Radius: 263  
 Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
 TAU SAU 10AU 20AU 30AU 40AU

# Mars

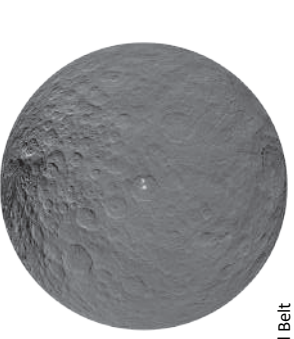
The fourth planet from the Sun



Gravity: 0.38 g  
 Density: 3.934  
 Rock  
 Radius: 3390  
 Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
 TAU SAU 10AU 20AU 30AU 40AU

# Ceres

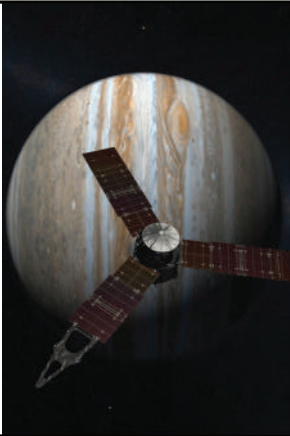
Dwarf planet and largest object in the Main Asteroid Belt



Gravity: 0.03 g  
 Density: 2.161  
 Rock Ice  
 Radius: 473  
 Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
 TAU SAU 10AU 20AU 30AU 40AU

**ATMOSPHERE**  
77

Jupiter's atmosphere contains traces of water vapor.



The Juno spacecraft orbiting Jupiter is trying to determine how much water is in its atmosphere.

**ATMOSPHERE**  
2

Mars' atmosphere contains traces of water, often visible as water-ice clouds.



Clouds observed by the Opportunity rover at Endurance Crater.

**SURFACE**  
42

Water ice is found on Mars at the polar caps.

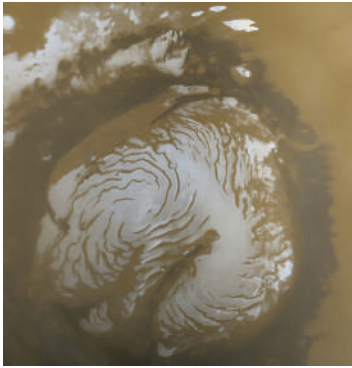



Image of the martian north polar cap acquired by the Mars Orbiter Camera.

**SUBSURFACE**  
22

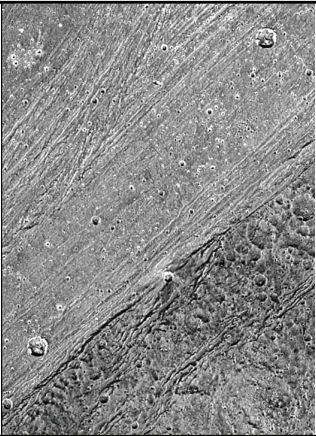
Water ice is found on Mars as ground ice and potential glacial deposits.



The Phoenix Mars lander discovered ground ice while digging troughs near the north polar region.

**SURFACE**  
32

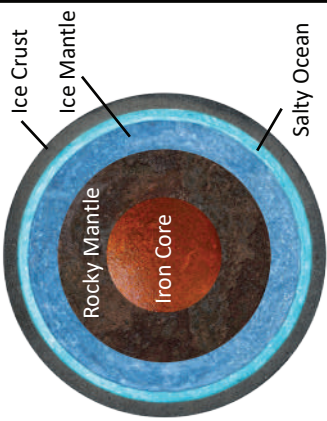
Water ice is widespread on the surface of Ganymede.



Ganymede's icy crust observed by the Galileo spacecraft.

**SUBSURFACE**  
285

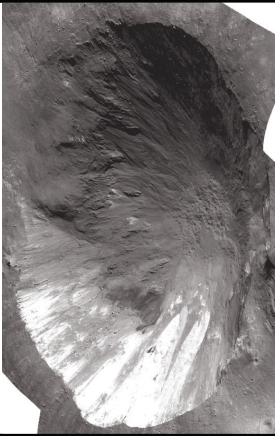
Ganymede may have a large ocean of liquid water deep in the subsurface.



Model of the interior of Ganymede.

**SURFACE**  
0

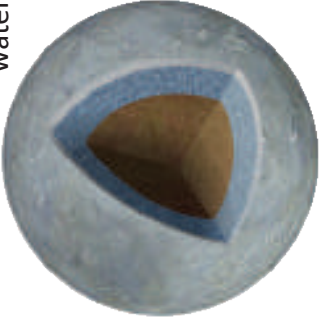
Vesta almost certainly does not have water ice today.



Gullies in a crater on Vesta, imaged by the Dawn spacecraft, likely formed by dry processes like landslides.

**SUBSURFACE**  
124

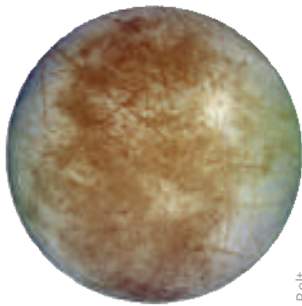
Ceres may contain a thin outer layer of dust and rock over a deeper layer of salty water ice.



Model of the interior of Ceres.

# Europa

The fourth largest moon of Jupiter

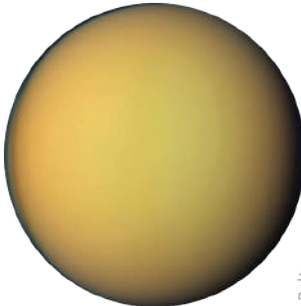


0.13g Gravity  
3.013 Density  
Rock  
Ice  
1561 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1 AU 5 AU 10 AU 20 AU 30 AU 40 AU

# Titan

The largest moon of Saturn

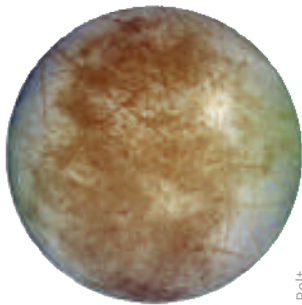


0.14g Gravity  
1.880 Density  
Rock  
Ice  
2576 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1 AU 5 AU 10 AU 20 AU 30 AU 40 AU

# Europa

The fourth largest moon of Jupiter

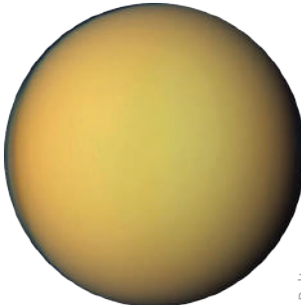


0.13g Gravity  
3.013 Density  
Rock  
Ice  
1561 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1 AU 5 AU 10 AU 20 AU 30 AU 40 AU

# Titan

The largest moon of Saturn

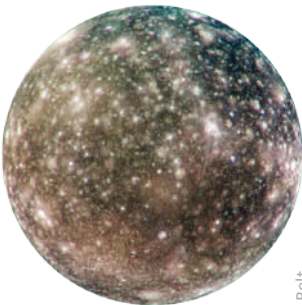


0.14g Gravity  
1.880 Density  
Rock  
Ice  
2576 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1 AU 5 AU 10 AU 20 AU 30 AU 40 AU

# Callisto

The second largest moon of Jupiter

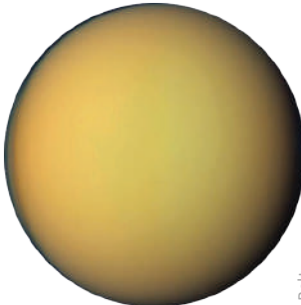


0.13g Gravity  
1.834 Density  
Rock  
Ice  
2410 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1 AU 5 AU 10 AU 20 AU 30 AU 40 AU

# Titan

The largest moon of Saturn




0.14g Gravity  
1.880 Density  
Rock  
Ice  
2576 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1 AU 5 AU 10 AU 20 AU 30 AU 40 AU

# Callisto

The second largest moon of Jupiter

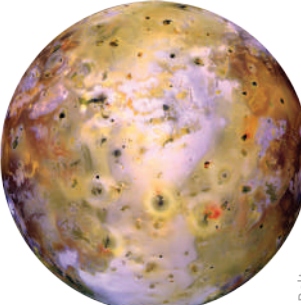


0.13g Gravity  
1.834 Density  
Rock  
Ice  
2410 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1 AU 5 AU 10 AU 20 AU 30 AU 40 AU

# Io

The third largest moon of Jupiter



0.18g Gravity  
3.528 Density  
Rock  
1822 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1 AU 5 AU 10 AU 20 AU 30 AU 40 AU

**19**

**SURFACE**

The surface of Europa is covered in water ice.



Grooves in the ice on Europa's surface, observed by the Galileo spacecraft.

**175**

**SUBSURFACE**

Deep beneath Europa's icy shell may be a layer of liquid or mostly liquid water.



Model of the liquid water ocean deep in Europa's subsurface.

**27**

**SURFACE**

The surface of Callisto is made up of a mixture of water ice and rock.

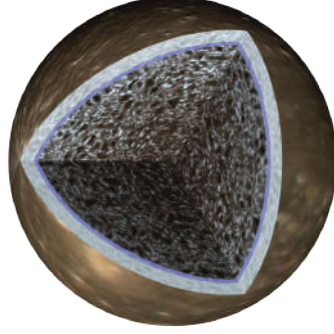


The surface of Callisto observed by the Galileo spacecraft.

**244**

**SUBSURFACE**

Callisto is thought to have a deep underground ocean of salty liquid water.

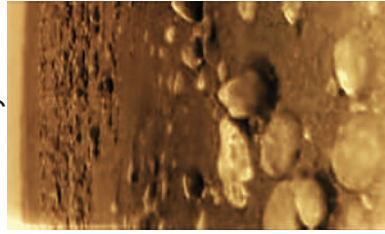


Model of the interior of Callisto.

**28**

**SURFACE**

Titan's surface is a mix of water ice and hydrocarbon ice.

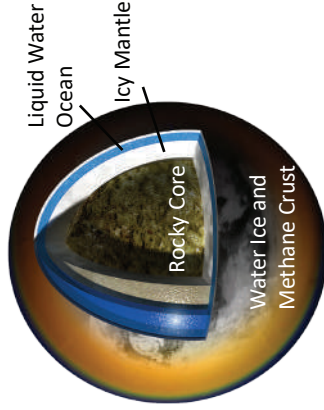


Rounded rocks and pebbles made of water ice, observed by the Huygens probe.

**255**

**SUBSURFACE**

Titan is thought to have an extremely salty subsurface ocean of liquid water.



Model of the interior of Titan.

**0**

**SURFACE**

Io is the most volcanically active body in the solar system, but has no water.



Active volcanic processes were observed on Io by the Galileo spacecraft.

**0**

**ATMOSPHERE**

Titan's thick atmosphere contains mostly nitrogen and methane, with very little water.

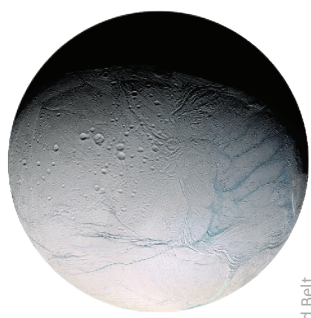


Titan's layered atmosphere: image captured by the wide-angle camera on the Cassini spacecraft.



# Enceladus

The sixth largest moon of Saturn

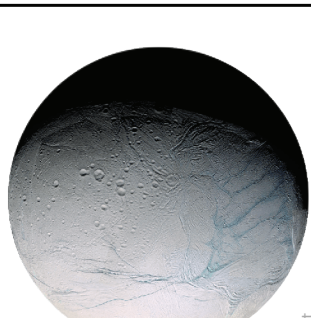


0.01g Gravity  
1.609 Density  
Rock  
Ice  
252 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

# Mimas

The seventh largest moon of Saturn

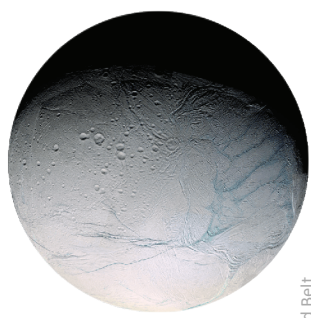


0.01g Gravity  
1.150 Density  
Rock  
Ice  
198 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

# Enceladus

The sixth largest moon of Saturn

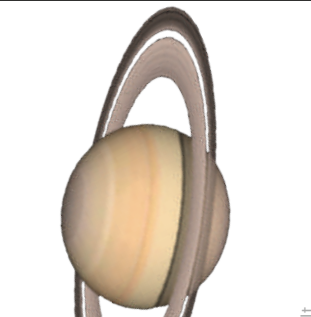


0.01g Gravity  
1.609 Density  
Rock  
Ice  
252 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

# Enceladus

The sixth largest moon of Saturn

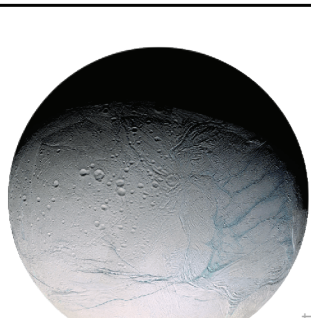


0.01g Gravity  
1.609 Density  
Rock  
Ice  
252 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

# Mimas

The seventh largest moon of Saturn

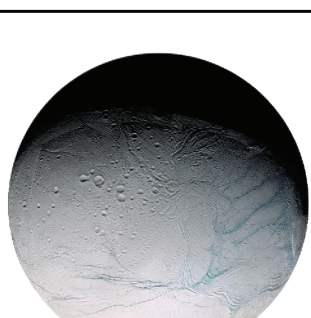


0.01g Gravity  
1.150 Density  
Rock  
Ice  
198 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

# Mimas

The seventh largest moon of Saturn

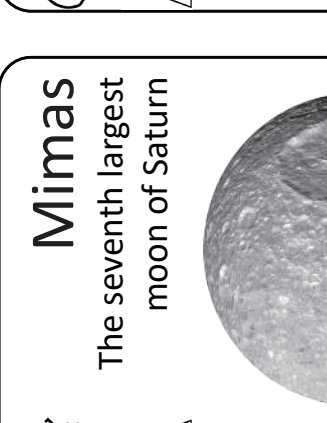


0.01g Gravity  
1.150 Density  
Rock  
Ice  
198 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

# Saturn

The sixth planet from the Sun

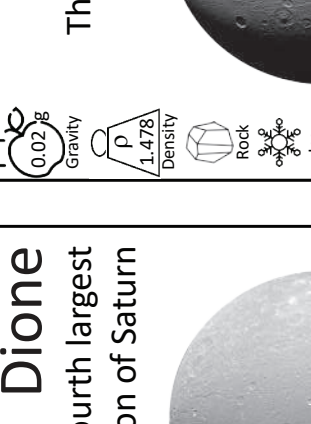


1.06g Gravity  
0.687 Density  
Gas  
58232 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

# Dione

The fourth largest moon of Saturn




0.02g Gravity  
1.478 Density  
Rock  
Ice  
561 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

# Saturn

The sixth planet from the Sun




1.06g Gravity  
0.687 Density  
Gas  
58232 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

# Dione

The fourth largest moon of Saturn

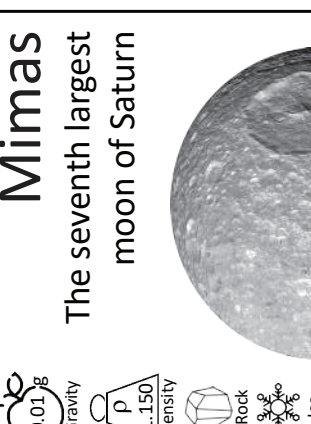


0.02g Gravity  
1.478 Density  
Rock  
Ice  
561 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

# Dione

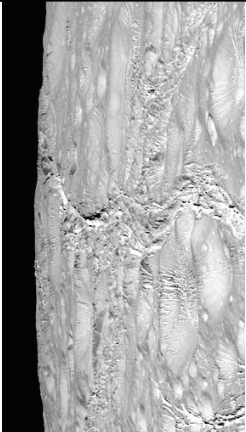
The fourth largest moon of Saturn



0.02g Gravity  
1.478 Density  
Rock  
Ice  
561 Radius

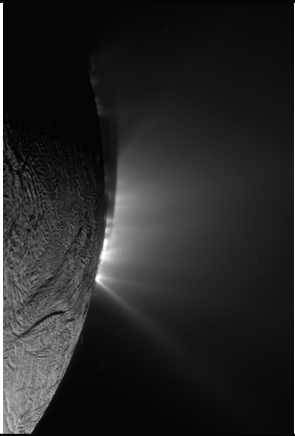
Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
10 AU 20 AU 30 AU 40 AU

**9** The surface of Enceladus is covered in water ice.



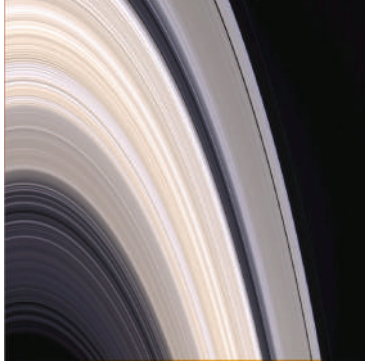
View of the north pole of Enceladus observed by the Cassini spacecraft.

**81** Enceladus may contain a subsurface ocean of liquid water.



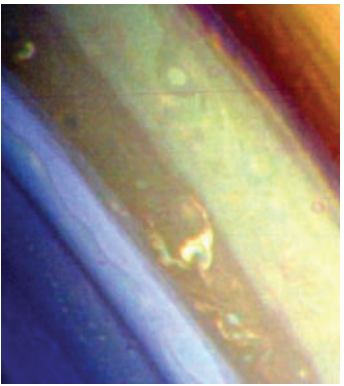
Plumes of water vapor and ice erupting from fractures were detected by the Cassini spacecraft.

**91** Saturn's rings are mostly made of water ice.



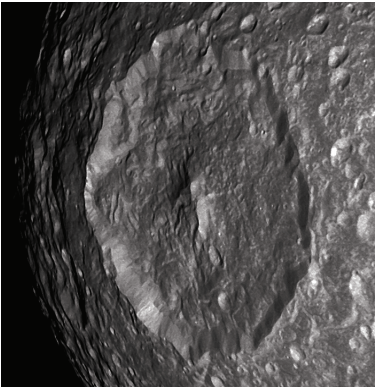
Color variations in Saturn's rings as seen by the Cassini spacecraft.

**72** Saturn's atmosphere contains trace water vapor.



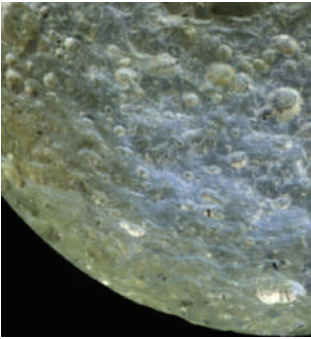
Enhanced color image of Saturn's atmosphere observed by the Cassini spacecraft.

**9** Mimas' surface is mostly made of water ice.



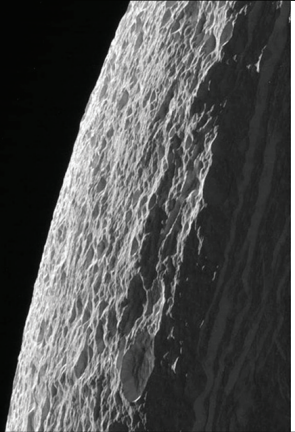
Herschel impact crater, 130 km across, observed by the Cassini spacecraft.

**79** Based on its density, Mimas is made of mostly water ice.



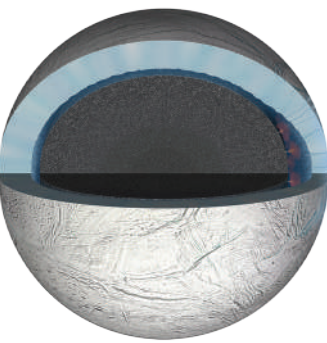
Enhanced color image captured by the Cassini spacecraft shows different colors that may be caused by different ices.

**14** Saturn's moon, Dione, has a mostly water ice surface.



The surface of Dione observed by the Cassini spacecraft.

**129** Dione may contain a deep subsurface ocean of liquid water.



Model of the interior of Dione.

# Rhea

The second largest moon of Saturn

0.03g Gravity  
1.233 Density  
Rock  
Ice  
764 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1AU 5AU 10AU 20AU 30AU 40AU

# Miranda

The fifth largest moon of Uranus

0.01g Gravity  
1.20 Density  
Rock  
Ice  
236 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1AU 5AU 10AU 20AU 30AU 40AU

# Rhea

The second largest moon of Saturn

0.03g Gravity  
1.233 Density  
Rock  
Ice  
764 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1AU 5AU 10AU 20AU 30AU 40AU

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Rock  
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236 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1AU 5AU 10AU 20AU 30AU 40AU

# Tethys

The fifth largest moon of Saturn

0.01g Gravity  
0.973 Density  
Ice  
533 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1AU 5AU 10AU 20AU 30AU 40AU

# Iapetus

The third largest moon of Saturn

0.02g Gravity  
1.083 Density  
Rock  
Ice  
736 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1AU 5AU 10AU 20AU 30AU 40AU

# Tethys

The fifth largest moon of Saturn

0.01g Gravity  
0.973 Density  
Ice  
533 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1AU 5AU 10AU 20AU 30AU 40AU

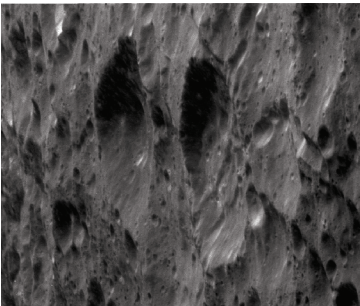
# Iapetus

The third largest moon of Saturn

0.02g Gravity  
1.083 Density  
Rock  
Ice  
736 Radius

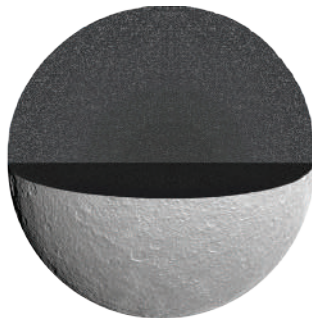
Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto  
1AU 5AU 10AU 20AU 30AU 40AU

**16** **SURFACE**  
Rhea's surface is mostly made of water ice.



Rhea's cratered surface observed by the Cassini spacecraft.

**141** **SUBSURFACE**  
Based on its density, Rhea is made of mostly water ice.



Rhea's internal structure is unknown. It may not be divided into layers.

**15** **SURFACE**  
Tethys' surface is made almost entirely of water ice.

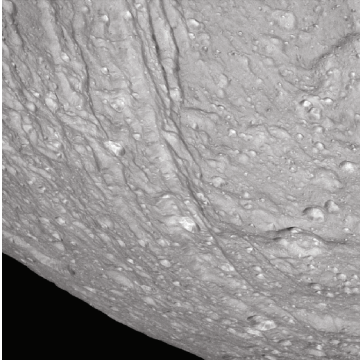
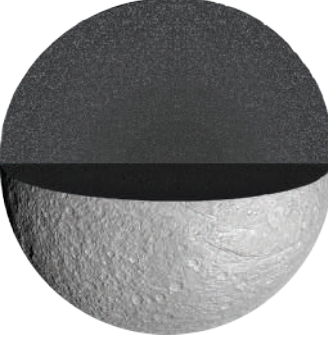


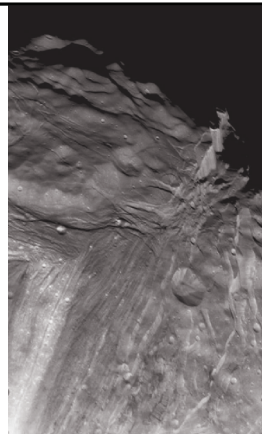
Image from the Cassini spacecraft shows steep, icy cliffs and craters.

**134** **SUBSURFACE**  
Based on its low density, Tethys is made almost entirely of water ice.



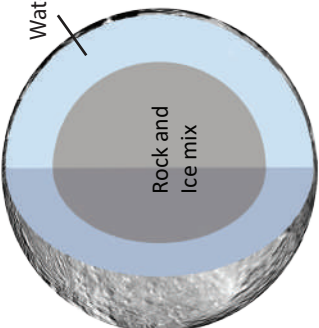
Tethys' internal structure is unknown.

**10** **SURFACE**  
The surface of Miranda is covered in water ice.



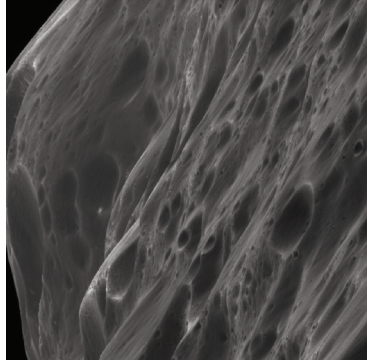
The surface of Miranda observed by the Voyager 2 spacecraft.

**86** **SUBSURFACE**  
The density of Miranda suggests that it is mostly made of water ice.



Model of the interior of Miranda.

**17** **SURFACE**  
Iapetus' surface is mostly made of water ice.



High mountains and impact craters observed by the Cassini spacecraft.

**153** **SUBSURFACE**  
Based on its density, Iapetus is made of mostly water ice.




Image from the Cassini spacecraft shows a mysterious high ridge that runs along the moon's equator.

# Triton

The largest moon of Neptune

0.08g Gravity  
2.061 Density  
Rock  
Ice  
1353 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Charon

The largest moon of Pluto

0.03g Gravity  
1.702 Density  
Rock  
Ice  
606 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Triton

The largest moon of Neptune

0.08g Gravity  
2.061 Density  
Rock  
Ice  
1353 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Charon

The largest moon of Pluto

0.03g Gravity  
1.702 Density  
Rock  
Ice  
606 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Neptune

The eighth planet from the Sun

1.14g Gravity  
2.0638 Density  
Gas  
Ice  
24622 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Pluto

A dwarf planet in the Kuiper Belt

0.06g Gravity  
1.854 Density  
Rock  
Ice  
1188 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Uranus

The seventh planet from the Sun

0.89g Gravity  
1.270 Density  
Gas  
Ice  
25362 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Pluto

A dwarf planet in the Kuiper Belt

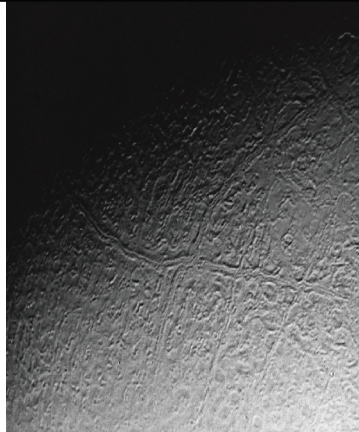
0.06g Gravity  
1.854 Density  
Rock  
Ice  
1188 Radius

Mercury Venus Earth Mars Asteroid Belt Jupiter Saturn Uranus Neptune Pluto

1AU 5AU 10AU 20AU 30AU 40AU

## SURFACE

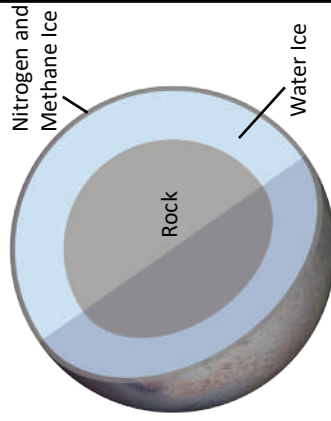
**24** Neptune's moon Triton has a mostly water ice crust.



Dirty water ice on Triton, observed by Voyager 2.

## SUBSURFACE

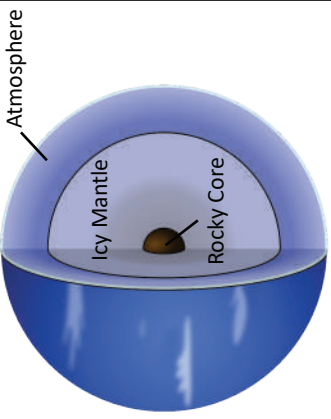
**213** Triton may have a large liquid or slushy ocean deep beneath its frozen surface.



Model of the interior of Triton.

## SUBSURFACE

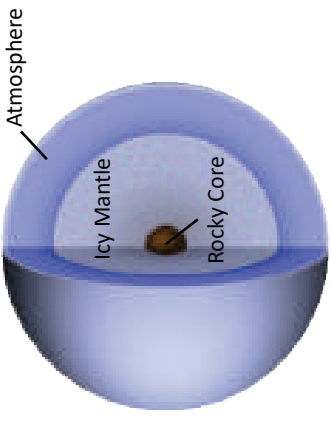
**197** The ice giant, Neptune, is thought to have an icy mantle beneath its atmosphere.



Model of the interior of Neptune.

## SUBSURFACE

**200** The ice giant, Uranus, is thought to have an icy mantle beneath its atmosphere.



Model of the interior of Uranus.

## SURFACE

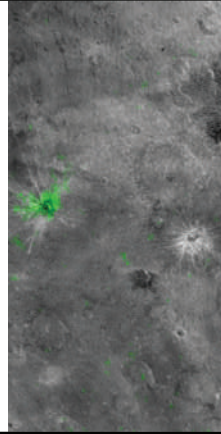
**15** The surface of Charon contains a mixture of ices, including water ice.



The New Horizons spacecraft discovered a long, deep canyon that encircles Charon.

## SUBSURFACE

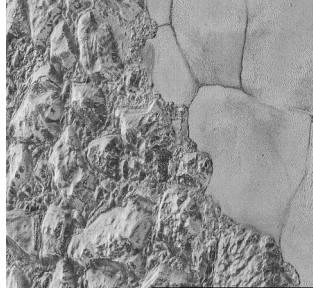
**137** Charon has water ice in its subsurface that may have been liquid in the past, and it may have ice geysers today.



The New Horizons spacecraft imaged craters made of different materials, including water ice and ammonia ice.

## SURFACE

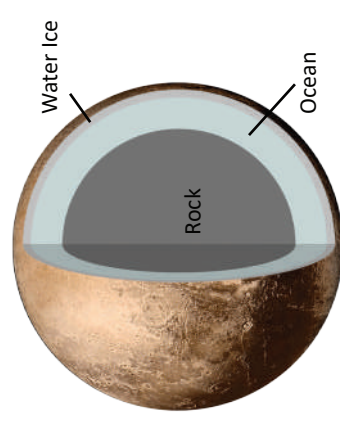
**21** Pluto's surface is covered by a combination of nitrogen-rich ices and water ice.



Large blocks of water ice form mountains, observed by the New Horizons spacecraft.

## SUBSURFACE

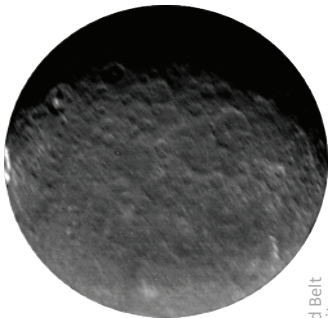
**187** Pluto is thought to have a subsurface ocean, about 100 kilometers deep.



Model of the interior of Pluto.

# Umbriel

The third largest moon of Uranus




0.02g Gravity  
1.390 Density  
Rock  
Ice  
585 Radius

Mercury  
Venus  
Earth  
Mars  
Asteroid Belt  
Jupiter  
Saturn  
Uranus  
Neptune  
Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Oberon

The second largest moon of Uranus



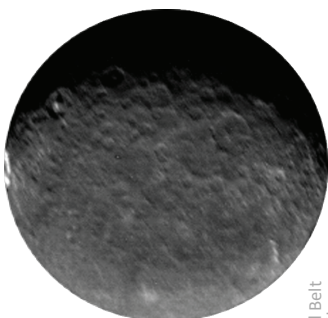
0.04g Gravity  
1.630 Density  
Rock  
Ice  
761 Radius

Mercury  
Venus  
Earth  
Mars  
Asteroid Belt  
Jupiter  
Saturn  
Uranus  
Neptune  
Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Umbriel

The third largest moon of Uranus




0.02g Gravity  
1.390 Density  
Rock  
Ice  
585 Radius

Mercury  
Venus  
Earth  
Mars  
Asteroid Belt  
Jupiter  
Saturn  
Uranus  
Neptune  
Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Oberon

The second largest moon of Uranus



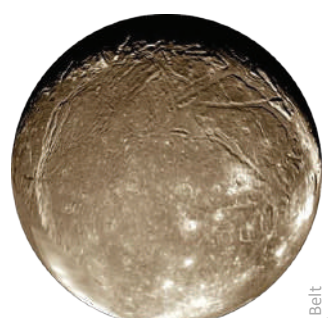
0.04g Gravity  
1.630 Density  
Rock  
Ice  
761 Radius

Mercury  
Venus  
Earth  
Mars  
Asteroid Belt  
Jupiter  
Saturn  
Uranus  
Neptune  
Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Ariel

The fourth largest moon of Uranus




0.03g Gravity  
1.592 Density  
Rock  
Ice  
579 Radius

Mercury  
Venus  
Earth  
Mars  
Asteroid Belt  
Jupiter  
Saturn  
Uranus  
Neptune  
Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Titania

The largest moon of Uranus




0.04g Gravity  
1.711 Density  
Rock  
Ice  
788 Radius

Mercury  
Venus  
Earth  
Mars  
Asteroid Belt  
Jupiter  
Saturn  
Uranus  
Neptune  
Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Ariel

The fourth largest moon of Uranus




0.03g Gravity  
1.592 Density  
Rock  
Ice  
579 Radius

Mercury  
Venus  
Earth  
Mars  
Asteroid Belt  
Jupiter  
Saturn  
Uranus  
Neptune  
Pluto

1AU 5AU 10AU 20AU 30AU 40AU

# Titania

The largest moon of Uranus

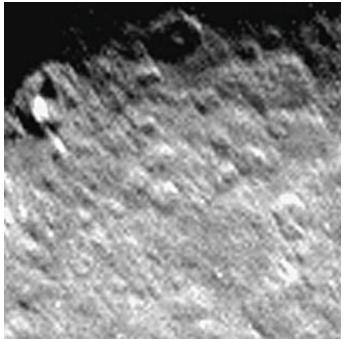


0.04g Gravity  
1.711 Density  
Rock  
Ice  
788 Radius

Mercury  
Venus  
Earth  
Mars  
Asteroid Belt  
Jupiter  
Saturn  
Uranus  
Neptune  
Pluto

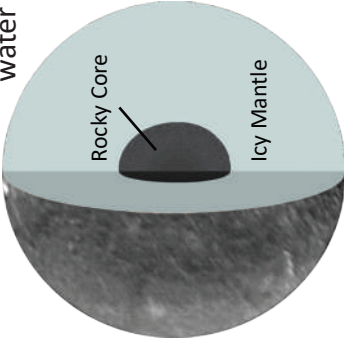
1AU 5AU 10AU 20AU 30AU 40AU

**15** **SURFACE** Umbriel's surface is made of water ice and carbon dioxide ice.



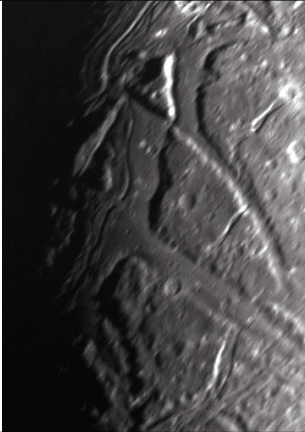
Umbriel's cratered surface imaged by the Voyager 2 spacecraft.

**138** **SUBSURFACE** Based on its density, Umbriel is made of mostly water ice.



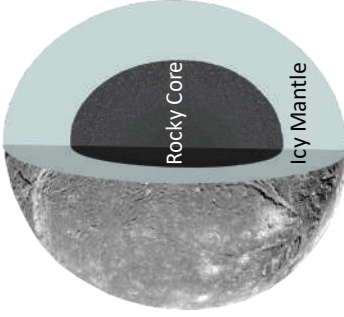
Umbriel may have a small rocky core and an icy mantle, but much is still unknown.

**15** **SURFACE** Ariel's surface is made of water ice and carbon dioxide ice.



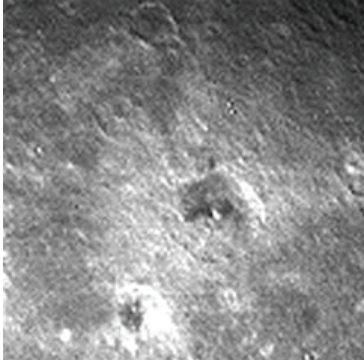
Canyons and craters on Ariel's surface imaged by the Voyager 2 spacecraft.

**133** **SUBSURFACE** Based on its density, Ariel is made of about half rock and half water ice.



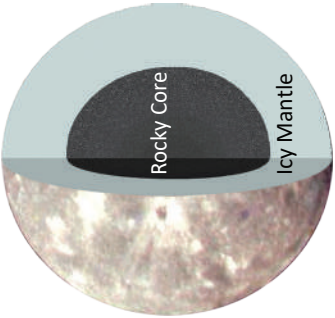
Ariel may have a rocky core and an icy mantle, but much is still unknown.

**17** **SURFACE** Oberon's surface is made of mostly water ice.



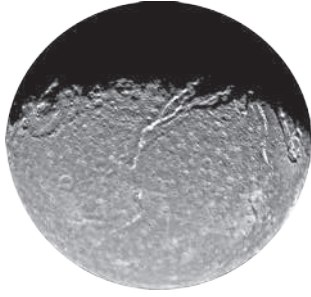
Oberon's surface imaged by the Voyager 2 spacecraft.

**154** **SUBSURFACE** Based on its density, Oberon is made of about half rock and half water ice.



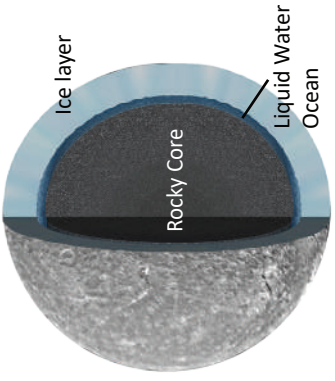
Oberon may have a rocky core and an icy mantle, but much is still unknown.

**17** **SURFACE** Titania's surface is made of water ice and carbon dioxide ice.



The Voyager 2 spacecraft captured images of Titania, showing craters as well as long rifts and canyons.

**156** **SUBSURFACE** There may be a layer of liquid water at the boundary of Titania's core and mantle.



Model of the interior of Titania.