Neighboring planets

Rosa M. Ros, Ricardo Moreno

International Astronomical Union
Polytechnical University of Catalonia, Spain
Colegio Retamar de Madrid, Spain

Justification

- This material is designed for teachers of children before starting primary school. Some content is presented to give the teacher more resources, although they may be too ambitious for such young children, but the questions that they may sometimes ask require broader knowledge to be able to rigorously explain the issues that may arise.

Goals

- Show in a simple way the meaning of the data on the planets of the Solar System that often appear in texts.
- Introduce, by playing, the set of movements of the Solar System
- Discover the Moons surface
- Consider the surfaces of some planets and moons

Solar System

- Models that are only manual work are not enough for us
- We want models with more content wich allow us to show some specific characteristics

Activity 1: Distances to the Sun

Mercury	57 900 000 km	6 cm	0.4 AU
Venus	108 300 000 km	11 cm	0.7 AU
Earth	149 700 000 km	15 cm	1.0 AU
Mars	228 100 000 km	23 cm	1.5 AU
Jupiter	778 700 000 km	78 cm	5.2 AU
Saturn	1 430 100 000 km	143 cm	9.6 AU
Uranus	2 876 500 000 km	288 cm	19.2 AU
Neptune	4 506 600 000 km	450 cm	30.1 AU

Activity 1: Distances to the Sun

- The astronomical units of distance (AU) is used to measure distances in the solar system. One AU corresponds to the distance from the Earth to the Sun, 150 million km.
- If we use a roll of toilet paper, where the units of paper for each use are marked, we can mark the distances of the planets from the Sun in a very simple way.

Activity 1: Distances to the Sun

- Mercury is a little less than half of the unit, Venus at three quarters (half of the half that remains to reach the unit), the Earth at the unit, Mars at one and a half units, Jupiter at a little more than 5 units, Saturn at just over 9 and a half units, Uranus at just over 19 units and finally Neptune at just over 30 units.
- It is a simple way to see that the first 4 planets are close and the others are increasingly farther and farther away.

Activity 2: Diameters

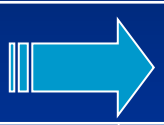
Sun	1 392 000 km	→	139.0 cm
Mercury	4 878 km	→	0.5 cm
Venus	12 180 km	→	1.2 cm
Earth	12 756 km	→	1.3 cm
Mars	6 760 km	→	0.7 cm
Jupiter	142 800 km	→	14.3 cm
Saturn	120 000 km	→	12.0 cm
Uranus	50 000 km	→	5.0 cm
Neptune	45 000 km	→	4.5 cm

Activity 2: Diameters

T-shirt with the scaled diameters of the planets

General scaled diameter model with the planets glued on the Sun.

Activity 3: Diameters and distances model

Sun	1 392 000 km			25.0 cm	
Mercury	4 878 km	57 900 000 km		0.1cm	10 m
Venus	12 180 km	108 300 000 km		0.2 cm	19 m
Earth	12 756 km	149 700 000 km		0.2 cm	27 m
Mars	6 760 km	228 100 000 km		0.1 cm	41 m
Jupiter	142 800 km	778 700 000 km		2.5 cm	140 m
Saturn	120 000 km	1 430 100 000 km		2.0 cm	250 m
Uranus	50 000 km	2 876 500 000 km		1.0 cm	500 m
Neptune	45 000 km	4 506 600 000 km		1.0 cm	800 m

Normally there is no schoolyard that reaches a distance beyond Mars

Activity 3: Model of diameters and distances in the court…

- We place a child in a corner of the yard with a basketball.
- Another boy/girl standing 10 strides away with a head pin in his hand. We consider 1 adult stride equivalent to one meter (with children it will be less, but it doesn't matter much because we prepare a scale model). The head of the pin will be Mercury.
- Another boy/girl in another direction at 19 strides with a fat-headed pin representing Venus.

Activity 3: Model of diameters and distances in the court…

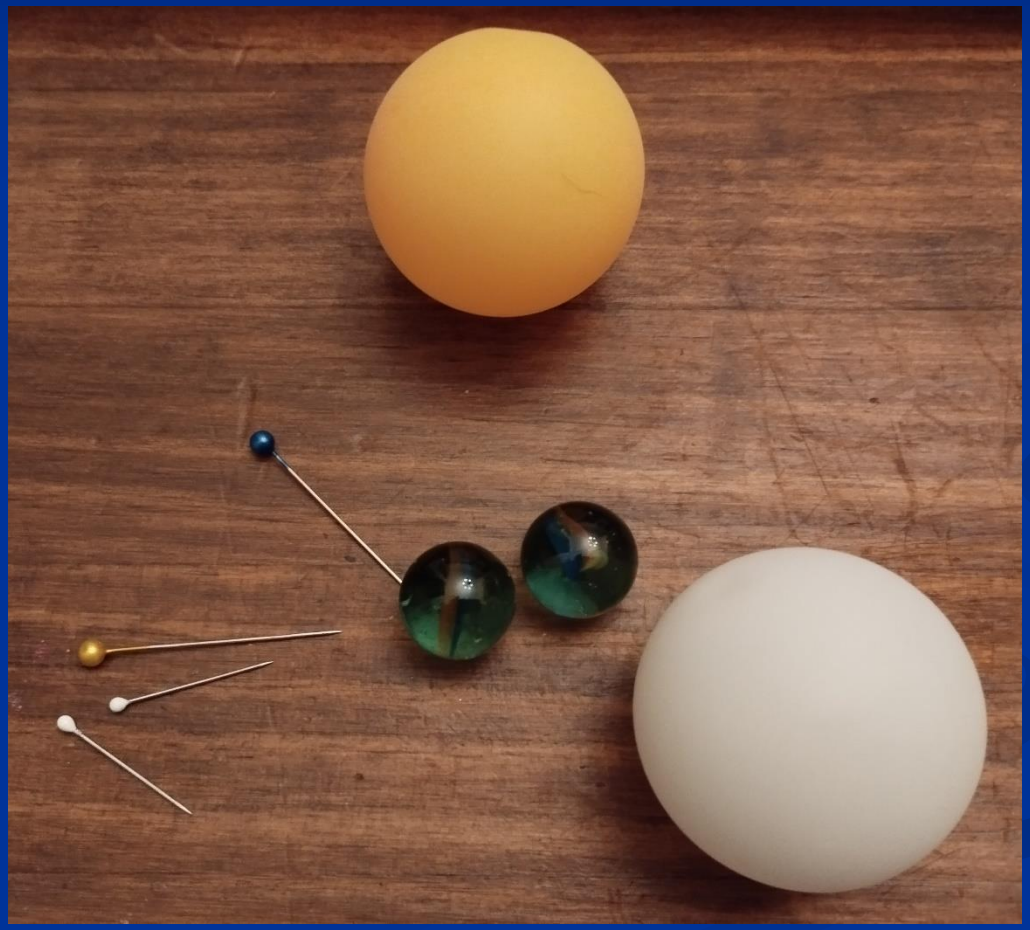
- Another child with a fat-headed pin will go in another direction, counting up to 27 strides and representing the Earth.
- Another child with a head pin located 41 strides away will be Mars.
- And so on, a golf ball at 140 strides is Jupiter, a ping pong ball at 250 strides is Saturn, and two marbles represent Uranus and Neptune respectively located at 500 and 800 strides.

Activity 3: Model of diameters and distances in the court…

Obviously it is impossible to organize a model like this in a school yard because it is too small and we cannot send a child that far...

but when the yard is finished we can tell them that Jupiter is in the house at the school gate. or that Saturn is in the ice cream store, etc... the idea is to mention places that they know

Activity 3: Model of diameters and distances in the court…



Activity 4: Model of distances with movement

- We painted a circle on the floor of the patio with chalk to represent the orbit of each planet centered on the Sun.

Activity 4: Model of distances with movement

Mercury	57 900 000 km		6 cm	0.4 AU
Venus	108 300 000 km		11 cm	0.7 AU
Earth	149 700 000 km		15 cm	1.0 AU
Mars	228 100 000 km		23 cm	1.5 AU
Jupiter	778 700 000 km		78 cm	5.2 AU
Saturn	1 430 100 000 km		143 cm	9.6 AU
Uranus	2 876 500 000 km		288 cm	19.2 AU
Neptune	4 506 600 000 km		450 cm	30.1 AU

Activity 4: Model of distances with movement

- A volunteer acts as a planet and will move following the chalk line until it completely circles the Sun. It is the translational or annual movement.
- Another volunteer does the same, but also with a simultaneous rotation movement on himself. Simulates daily rotation movement.
- A third volunteer is circling around the second: it is a moon around the planet.

Activity 4: Model of distances with movement

- It is necessary to mention that with these movements some can pass in front of the others or in the middle of the direction in which other planets are and cover each other: transits and eclipses occur.

Activity 5: Orbital period model

- The translational movement is faster for the inner planets and slower for the outer ones.
- We will simulate this situation with a simple model. We hold a rope at the opposite end to which we have fixed a nut and we make it rotate like a sling above our head

Activity 5: Orbital period model

- As we release the rope we will see that it takes more time to make a complete circle (an orbit).

- If we remove the rope, it takes less time to turn around (it is good to pass the rope through the inside of a small tube so as not to erode the hand if the rope is removed quickly)

Activity 6: Terrestrial and gaseous planets

Mercury	5.41 g/cm3	4 878 km
Venus	5.25 g/cm3	12 180 km
Earth	5.52 g/cm3	12 756 km
Mars	3.90 g/cm3	6 760 km

Jupiter	1.33 g/cm3	142 800 km
Saturn	0.71 g/cm3	120 000 km
Uranus	1.30 g/cm3	50 000 km
Neptune	1.70 g/cm3	45 000 km

Activity 6: Terrestrial and gaseous planets

Terrestrial planets

- Mercury, Venus, Earth and Mars.
- Smaller and closer to the Sun
- Without or with few satellites (0, 0, 1 and 2 respectively)

Gaseous planets

- Jupiter, Saturn, Uranus and Neptune.
- Bigger and farther from the Sun
- With many satellites
- With rings of ice and dust

Activity 6: Terrestrial and gaseous planets

Terrestrial planet

- Model of the Earth with modeling clay of 2.6 cm in diameter

Credit: NASA

Activity 6: Terrestrial and gaseous planets

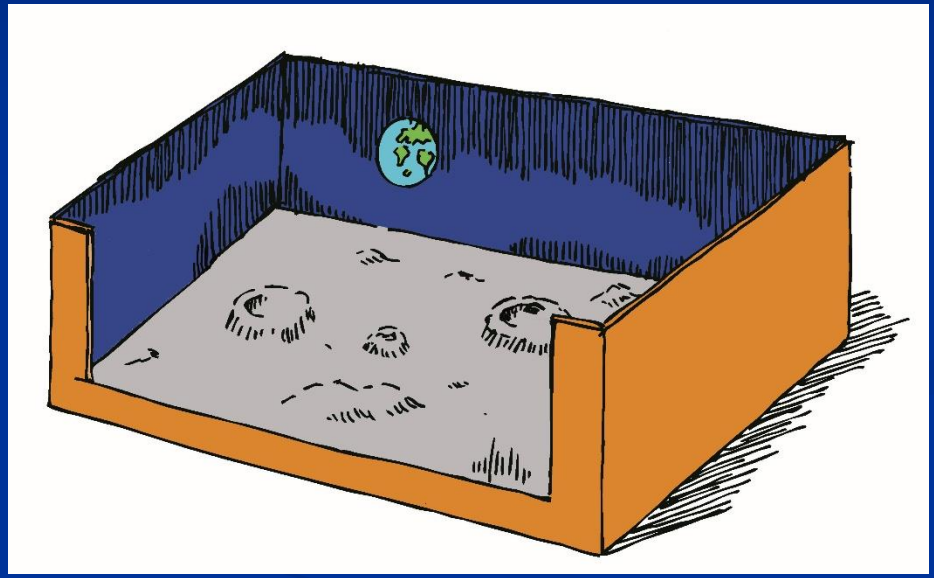
Gaseous planets

- Jupiter model with bubble paper, 28.5 cm in diameter

Credit: NASA

Activity 7: Dioramas

- **We know what the surface of the Earth, the Moon and Mars look like.**
- **We make dioramas of each of these places.**
- **We simulate the surface with craters or not, and we paint the sky.**



- The light of the Sun is colorful. In the atmosphere of the Earth, due to its composition, the blues have "won", in that of Mars the pinks "won" and on the Moon there is no atmosphere and the sky looks black

Activity 7: Diorama of Mars

The surface of Mars is reddish due to iron oxides.

Credit: NASA

Credit: NASA

The atmosphere of Mars is very weak and there is a lot of dust in suspension, so the sky looks pink-orange. You have to paint the sky pink or orange. You can put a "rover" whose design does not need to be aerodynamic!

Activity 7: Diorama of Mars

Example of the reddish surface of Mars, the pink atmosphere and the non-aerodynamic "rover"

Activity 7: Diorama of the Moon

We simulate the surface of the Moon with powdered cement, ash or with flour and cocoa. It must have craters.

On the Moon, since there is no atmosphere, you have to paint the sky black and maybe... put an astronaut in a diving suit, there is no air to breathe.

Credit: NASA

Credit: NASA

Activity 7: Diorama of the Moon

Example of the surface of the Moon with craters, black sky and an astronaut in a diving suit, because there is no air to breathe.

Activity 7: Diorama of the Earth

The Earth's surface usually has vegetation and you can put some animal, it is the planet of life and perhaps... an aerodynamic car

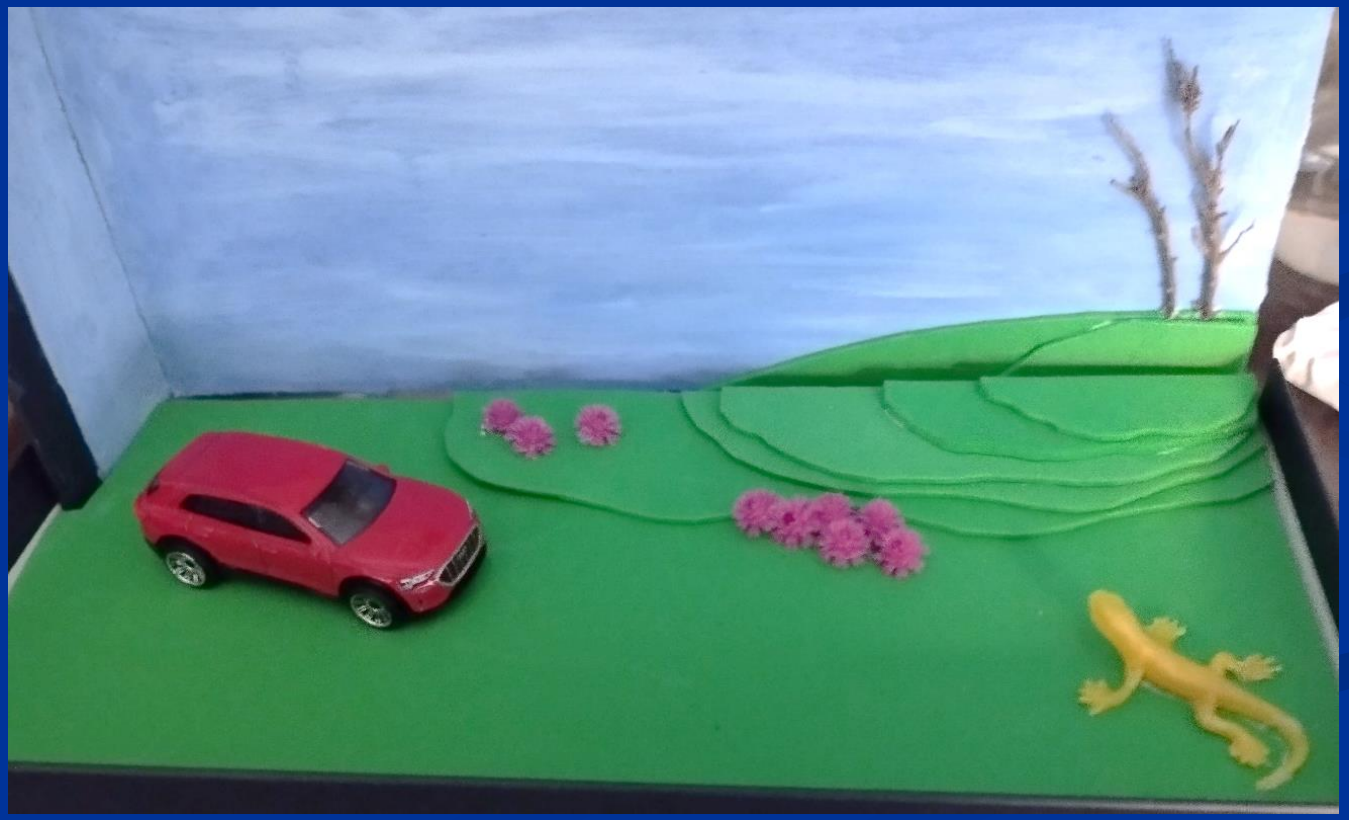
Credit: Martingraf

Credit: Pixabay

The Earth's atmosphere is much denser than that of Mars. You have to paint the sky blue.

Activity 7: Diorama of the Earth

Example of the Earth's surface with the blue sky, vegetation and some small animals and an aerodynamic car



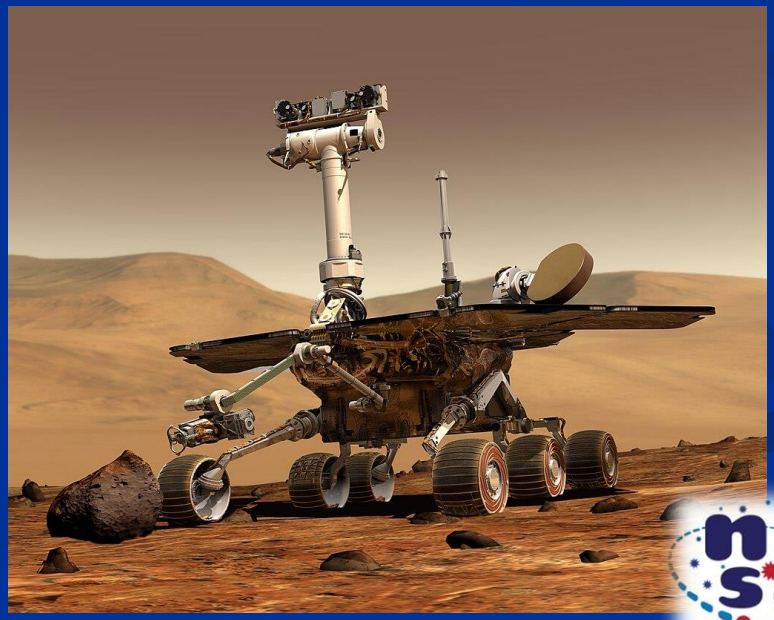
Smell of the Moon

- On the Moon without an atmosphere you can't smell anything.
- The astronauts who walked on the Moon returned to the module with small amounts of lunar dust in their suits and most of them agree that its smell is reminiscent of a mixture between ashes and “burnt gunpowder”, like “chimney ashes”.

Smell of Mars

The "rovers" have revealed that the Martian atmosphere is rich in CO_2 (96%), which does not contribute any aroma to the environment, but is also composed mainly of iron, magnesium, sulphur and acids that can give off the smell of "rotten eggs." .

Presumably the surface must give a certain ferrous smell due to iron oxides



Conclusions

- Know experimentally the dimensions of the planets.
- Establish relationships for a better understanding of the dimensions of the Solar System and the size of the main bodies in it: the Solar System "is empty."
- Know the translation and rotation movements of the planets.
- Know some characteristics of the surfaces of some planets and the Moon

Thank you very much
for your attention!