ALMA is more connected to asteroids than you think. Studying these space rocks is very important if we want to understand our cosmic origins and prevent possible asteroid collisions with Earth. Although the probability is low, it never ceases to exist.

ALMA observes millimetric and submillimetric radio waves, capturing images from the radiation produced by asteroids. Identifying these is important because no two asteroids are alike. They all have different sizes and compositions that have not changed since the Solar System was created.

Commemorate with us on June 30, International Asteroid Day!
INSTRUCTIONS

REQUIREMENTS OF THE GAME

• 1 to 6 players.
• A player-moderator or “head of records”.
• 1 pencil per player (to write down information and draw your asteroid).
• Printable “asteroid record” sheet or one paper per player to take notes.
• 1 small rock or other object per player (this will be your chip and the shape of your asteroid).
• 1 die for the entire game.

RULES

1. First decide which player will be the game moderator. The mission of the moderator will be to keep the data sheets and ensure the rules are followed.

2. To decide who starts, each player throws the die. Whoever rolls the highest number goes first. All players must draw the shape of their asteroid before the game begins.

3. The players take turns in a clockwise direction.

4. Each player rolls the die at the beginning of their turn and moves the amount of squares corresponding to the number on the die.

5. There are 4 types of squares you can land on: Data, traps, questions and drawings.

6. Along the way, you will find 4 total milestones (dotted lines after the squares), which will help you add valuable information about your asteroid.

7. Traps, Superpowers and Milestones

8. End of game

Good luck on the race!
Based on the number that you roll on the die to cross the border, you can find your characteristic and write it down on your record sheet.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>TEXTURES</th>
<th>HAZARD LEVEL</th>
<th>CENTER</th>
<th>FINAL ORBIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SMOOTH</td>
<td>NEAR AND INOFFENSIVE</td>
<td>GOLD</td>
<td>COLLIDED</td>
</tr>
<tr>
<td>XII</td>
<td>Smooth and slippery.</td>
<td>Your diameter is small like a tennis ball. If you touch the Earth's atmosphere, you will disintegrate.</td>
<td>A single asteroid may contain more gold than all the gold on Earth.</td>
<td>You enter the Earth's atmosphere and fall into the ocean. If you are inoffensive, you wreck no havoc. If you are hazardous, you cause tidal waves in nearby oceans.</td>
</tr>
<tr>
<td>2</td>
<td>RUDELL CUMULUS</td>
<td>FAR AND INOFFENSIVE</td>
<td>WATER</td>
<td>OBSERVED</td>
</tr>
<tr>
<td>XII</td>
<td>Joined by gravity like a series of mud balls.</td>
<td>You may be big like a city, but you orbit far from the Earth and you are unlikely to come close to Earth.</td>
<td>This is the most sought-after element, which is more valuable than any other.</td>
<td>You were successfully observed. If you are inoffensive, you enter the registry of new asteroids. If you are hazardous, a space probe will visit you. We will be there soon!</td>
</tr>
<tr>
<td>3</td>
<td>ROCKY</td>
<td>HUGO AND INOFFENSIVE</td>
<td>PLATINUM</td>
<td>COLLIDED</td>
</tr>
<tr>
<td>XII</td>
<td>With multiple vertices and faces like common stones.</td>
<td>Your diameter is 948 kilometers, like the dwarf planet Ceres. However, your orbit is far from Earth.</td>
<td>This is a very rare and very expensive precious metal that is used in the aerospace industry.</td>
<td>You come straight towards Earth. If you are small, the atmosphere will disintegrate you, but if you are large, you fall on a city and appear in all the headlines.</td>
</tr>
<tr>
<td>4</td>
<td>DOUBLE</td>
<td>MEDIUM HAZARD</td>
<td>FIRE</td>
<td>OBSERVED</td>
</tr>
<tr>
<td>XII</td>
<td>Two asteroids that were slowly drawn together and now orbit together in the same space.</td>
<td>You measure less than 140 meters in diameter but you are 8 million kilometers from Earth.</td>
<td>A burning, incandescent core resulting from the combustion of many heavy metals.</td>
<td>ALMA successfully identified you, you are part of the Chilean asteroid registry.</td>
</tr>
<tr>
<td>5</td>
<td>CHONDULES</td>
<td>POTENTIAL HAZARD</td>
<td>IRON</td>
<td>COLLIDED</td>
</tr>
<tr>
<td>XII</td>
<td>Remains of different colored rocks that form a single body.</td>
<td>You measure more than 140 meters in diameter and you are less than 8 million kilometers from Earth.</td>
<td>This is not so valuable but it is a metal commonly used on Earth.</td>
<td>You crashed into Earth! If you are inoffensive, you fall in a desert. If you are hazardous, you divert the Earth's axis and extinction is imminent.</td>
</tr>
<tr>
<td>6</td>
<td>POROUS</td>
<td>HIGH HAZARD</td>
<td>ICE</td>
<td>OBSERVED</td>
</tr>
<tr>
<td>XII</td>
<td>Full of holes, like a sponge, produced by previous impacts. Similar to the surface of the Moon.</td>
<td>You are enormous and your orbit is hard to predict, because you are very far away and not very bright.</td>
<td>Cold core like dry ice, which is solid Carbon Dioxide.</td>
<td>If you are inoffensive, you enter the asteroid registry. If you are hazardous, the planetary protection mission launches a missile to divert you.</td>
</tr>
<tr>
<td>7</td>
<td>SMOOTHER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Smooth and slippery.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>RUBBLE CUMULUS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Joined by gravity like a series of mud balls.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>ROCKY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>With multiple vertices and faces like common stones.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>DOUBLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Two asteroids that were slowly drawn together and now orbit together in the same space.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>CHONDULES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Remains of different colored rocks that form a single body.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>POROUS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Full of holes, like a sponge, produced by previous impacts. Similar to the surface of the Moon.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>SMOOTHER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Smooth and slippery.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>RUBBLE CUMULUS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Joined by gravity like a series of mud balls.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>ROCKY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>With multiple vertices and faces like common stones.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>DOUBLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Two asteroids that were slowly drawn together and now orbit together in the same space.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>CHONDULES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Remains of different colored rocks that form a single body.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>POROUS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td>Full of holes, like a sponge, produced by previous impacts. Similar to the surface of the Moon.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
You lose your next turn.

The next player loses 1 turn.

You move back 1 square.

The previous player moves forward 1 square.

The game changes direction.

All players move forward 1 square except you.

If you don't like the number you rolled on the die, you can roll again.

Before each turn you can choose to move forward 1 square.

Before each turn you can choose any other player to move back 1 square.

If you don't like the number you rolled on the die, you can roll again.

Where did the asteroid land that extinguished the dinosaurs?
- a) Africa
- b) Mexico

What do you call the remains of asteroids that reach Earth?
- a) Comets
- b) Meteorites

The asteroid that eliminated 75% of all Cretaceous species created:
- a) Nuclear winter
- b) Nuclear spring

Why is it important to know about asteroids?
- a) To learn about our cosmic origins
- b) To strengthen planetary protection
- c) For future space mining projects
- d) All of the above

Where is the Asteroid Belt located?
- a) Between Mercury and Venus
- b) Between Mars and Jupiter

What is the acronym used for asteroids close to Earth?
- a) NEA (Near Earth Asteroid)
- b) NEOA (Near Earth Orbit Asteroid)

What are asteroids?
- a) Rocks from the Solar System
- b) Space garbage of no importance

When is asteroid day?
- a) October 12
- b) June 30

What is the name of the asteroid that became a dwarf planet?
- a) Cedric
- b) Ceres

Are asteroids the same as the Moon?
- a) Yes
- b) No

Where have the last two major meteorite impacts occurred?
- a) China
- b) Russia

Why is it so hard to observe asteroids?
- a) Because there are so many
- b) Because they have poor radiation and are very dark
- c) All of the above

Asteroid day is June 30 because on this date:
- a) A large meteorite fell on Russia in 1908
- b) Ceres was discovered

Space mining would be used to:
- a) Extract minerals from asteroids
- b) Find life in rocks

What is the name of an asteroid observed by ALMA?
- a) Juno
- b) Zeus

According to scientists, what do comets smell like?
- a) Pestilence
- b) Flowers

How are asteroids and meteorites different?
- a) Size
- b) Whether or not they impact Earth

Are asteroids only located on the belt between Mars and Jupiter?
- a) Yes
- b) No

What is the difference between a comet and asteroid?
- a) An asteroid has a tail
- b) A comet has a tail

What is a meteor?
- a) A luminous phenomenon
- b) A climatic phenomenon

How many antennas does ALMA have?
- a) 56
- b) 66

What is the Palermo staircase?
- a) A system to count Near Earth Asteroids
- b) A hazard measurement system for objects close to Earth.

1. b; 2. b; 3. a; 4. d; 5. b; 6. a; 7. a; 8. b; 9. b; 10. b; 12. c; 13.a; 14.a; 15.a; 16.a; 17.b; 18.b; 19.b; 20.a; 21.b; 22.b;
1) There may be 100,000 tons of platinum in a single asteroid (with a 1 km diameter).
2) A single asteroid may contain more platinum and gold than all the platinum and gold on Earth.
3) Asteroids are enormous space mines full of minerals.
4) The gravitational pull of Jupiter prevents asteroids on the Belt from joining together and forming new planets.
5) Meteorites are asteroid fragments that have fallen to Earth.
6) Meteorites tend to be more visible from Earth than asteroids or comets. They are commonly known as shooting stars.
7) In 1801, Guiseppe Piazzi discovered the shadow of a very large element located between Mars and Jupiter, which turned out to be the largest asteroid in the Solar System, Ceres, currently a dwarf planet.
8) Ceres is the largest asteroid in the Solar System, the first to be discovered, and is now a dwarf planet.
9) According to NASA, the dwarf planet Ceres had geological activity corresponding to ice volcanoes fed by an ancient underground sea.
10) Almost one million asteroids have been identified between Mars and Jupiter in the region known as the Asteroid Belt.
11) Asteroids have the same resources as Earth and planets were created as a result of many of these bodies coming together.
12) The UN has a Committee on the Peaceful Uses of Outer Space, which declared International Asteroid Day.
13) The Hygiea asteroid was observed from the Atacama Desert, which could displace Ceres as the smallest known dwarf planet in the Solar System.
14) Planets and asteroids have an incandescent core, provoked by the radioactive disintegration of heavy metals.
15) The existence of rare metals and precious stones on Earth can be explained by the subsequent impact to their formation, called the “late heavy bombardment” of asteroids.
16) If you use jewelry made from precious metals or stones, you are using the remains of an asteroid that collided to form Earth.
17) Psyche is one of the most interesting asteroids on the Asteroid Belt due to the amount of rare metals it may contain.
18) Some of the requirements for an asteroid to transform into a dwarf planet include: orbiting around the Sun, not being a moon, and having enough mass that its own gravity pushes it into a more or less spherical shape.
19) Asteroid families are remains of rocks from the same origin, which probably collided, and when they destructed they continued to orbit in the same sector in the shape of small brother fragments.
20) The type M (or metallic) Psyche asteroid, which has a 200-km diameter, is believed to contain platinum and gold in its core, estimated at a value of US$ 10,000 quadrillion. That is more than all the money in the world!
21) Comets and meteorites are not the same. The first contain ice and a very long tail. The Halley comet is one of the most famous comets.
22) The European Space Agency (ESA) discovered that comets, celestial bodies with a tail, which are not the same as asteroids, have a pestilent odor, a cross between rotten eggs, barnyards and formaldehyde (similar to acetone).
23) The Bennu asteroid may cross the Earth’s orbit towards the end of the 22nd century. Studying it is important to prevent a possible collision with our planet.
24) NASA’s OSIRIS-REx probe is a mission that collected samples from the Bennu asteroid in 2020 and will return in 2023 to contribute to the study of these celestial bodies.
25) The study of the Bennu and Psyche asteroid is important because they provide clues about the origin of life and the Solar System.
26) In 2022, Space X and NASA will send a space mission to explore the “gold asteroid,” Psyche.
27) The dwarf planet Ceres may contain all the elements necessary to generate life in microscopic form.
28) Thanks to its antennas, ALMA was able to observe the asteroid Juno in 2015 and confirmed that it is potato-shaped.
29) Studies show that the asteroid that extinguished the dinosaurs was fatal because of its large size and the 60º angle at which it impacted Earth.
30) It is believed that the asteroid that extinguished the dinosaurs had a diameter between 12-15 kilometers and fell on the Yucatan Peninsula in Mexico.
31) The crater caused by the meteorite that extinguished the dinosaurs created a crater with a diameter of approximately 193 kilometers.
32) The “nuclear winter” was provoked by the large amount of dust and soot released on the Earth’s surface after the impact of the meteorite that extinguished the dinosaurs, because it affected the light and oxygen on the face of the Earth and acidified the seas, which is incompatible with life.
33) A meteorite was discovered from Chile, which was baptized Vaca Muerta (Dead Cow).
34) Amor, Apollo and Aten are the names of the asteroids closest to Earth.
43) The Kirkwood gaps are areas in the Asteroid Belt where the density of the rocky bodies is lower.

44) Meteoroid is a small piece of asteroid. It is called a meteor when it enters the Earth’s atmosphere and a meteorite if it collides with Earth. There are over 65,000 meteorites cataloged by the Meteorigical Society, an international organization founded almost a century ago.

45) There is a classification of “questionable” meteorites, which means it is unclear whether they are actually pieces of space rock or not, but they are still registered.

46) Metal asteroids make up 4% of all asteroids in the Solar System.

47) If two asteroids collide, they may divert potentially hazardous debris towards Earth, but this is highly unlikely because although there are millions, they are quite spread out on the Asteroid Belt.

48) Jupiter is the great defender of the Earth. Its orbit prevents centaur asteroids from getting close to us.

49) Asteroids can explain our cosmic origins.

50) The Moon has around 8,000 asteroid impacts on its surface.

51) International Asteroid Day commemorates the anniversary of the impact in Tunguska in Siberia (Russia) on June 30, 1908, which crushed 80 million trees. It seeks to raise public awareness of the potential danger of an asteroid impact.

52) It is easier to divert the orbit of an asteroid by hitting it than by destroying it with a missile, because the debris could impact Earth.

53) According to NASA, there are 26,112 Near Earth Asteroids (NEAs), 886 of them over 1 kilometer long.

54) There are around 10 asteroids that are approximately 1 kilometer long and close to Earth, which have been difficult to observe because they are not metallic and therefore do not reflect light well. They all belong to the Karma family, discovered in 1953.

55) You can find a database and photographs of space rocks found on Earth in the online Meteorite Encyclopedia. Its website (in English) is http://encyclopedia-of-meteorites.com

56) In 2016, the United Nations declared June 30 International Asteroid Day.

57) The last two major collisions were in 1908 in Siberia and 2013 in Chelyabinsk, both in Russia. During this last event, over 1,000 people were injured when a 17-meter, 10,000-ton meteorite exploded.

58) There is an International Asteroid Warning Network. It involves communication plans and detailed protocols to assist governments in evaluating the possible consequences of an asteroid impact and support threat response planning.

59) Comets and meteorites are not the same. The first contain ice and have a very long tail. The Halley comet is one of the most famous.

60) Atlas is an asteroid impact warning system that has two telescopes in Hawaii, and in 2021 it will install two new ones, one in Africa and the other in Chile.

61) The new Atlas telescope used to search for hazardous asteroids will be installed in the El Sauce Observatory in the Coquimbo region and will be operational in late 2021. It will be able to provide a one-day warning of any asteroid impact capable of destroying an entire town.

62) The European Southern Observatory (ESO) and the European Space Agency (ESA) are building a prototype in the La Silla Observatory in the Coquimbo Region, an asteroid tracking device known as TBT2.

63) Flyeye is a joint project between the European Southern Observatory (ESO) and the European Space Agency (ESA) to install an asteroid tracking device from Chile.

64) The Vera Rubin observatory, soon to be located in the Coquimbo region, will have an 8.4-meter mirror to track asteroids and contribute to the planetary protection plan for these types of impacts.

65) NASA is in the preliminary stages of designing an infrared space telescope to find asteroids that are dark and almost impossible to detect due to their composition.

66) The Palermo Technical Impact Hazard Scale is a logarithmic scale (from 1 to 10) whose function is to measure the risk of impact of a Near Earth Object (NEO).