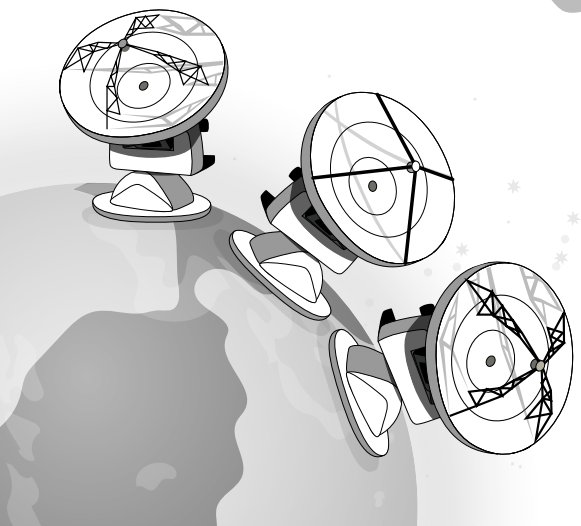
ALMAsteroids

What type of asteroid are you?



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. Identifyiang 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!

ALMAsteroids

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.

5.1 Data Squares

- If you land on a data square, you must choose a number between 1 and 66 (you cannot repeat a number that was already chosen). The game moderator reads from the list of data (which is found in the information that comes with the game) the information that corresponds to the number chosen by the player. Once the data has been read with complementary information about asteroids, it is the next player's turn.

5.2 Trap Squares

- If you land on a trap square, the game moderator must read from the list of traps (information that comes with the game) the number of the trap indicated on the square where you landed, and then you must follow the instructions indicated.

5.3 Question Squares

- Every time you land on a data square, you must choose a number between 1 and 22 (numbers cannot be repeated). The game moderator will read a multiple-choice question from the list of questions that comes with the game. If you answer correctly, you will earn a superpower for your asteroid, which is specified in the list of superpowers that comes with the game. You can earn up to 3 superpowers and these will be valid for the duration of the game.

5.4 Drawing Squares

- If you land on this square, you earn the right to draw 1 of the following 6 elements on your asteroid:
- Sunglasses • Arms and legs • Wings
- Wig • Hat • Scarf

6 Milestones

- Along the way, you will find 4 total milestones (dotted lines after the squares), which will help you add valuable information about your asteroid.
- When you cross a milestone, the game moderator will read the corresponding one from the list of milestones (that comes with the game) based on the number you rolled on the die on your most recent turn. You must write down the new information on your asteroid record sheet.

7 Traps, Superpowers and Milestones

- If you have to move your chip because of a trap or superpower, the square you land on will have no effect.
- If it is your turn and you cross a milestone because of a trap or superpower, the game moderator must read the new information based on the last number you rolled on the die.

8 End of game

- The winner is the first player to land on one of the 6 numbered squares around the Sun, located at the center of the board, to correctly guess (before rolling the die) whether to collide or to be observed.
- For this, you need to land on the exact goal square. If you don't roll the exact number, you will have to move back the number of corresponding squares, based on the number you rolled on the die.
- Once you reach the goal, you must choose between being observed or colliding with Earth, and then roll the die. Odd numbers (1, 3 and 5) mean that you collided with Earth, and even numbers (2, 4 and 6) mean that you were observed.
- The game moderator will read about the development of your asteroid because each square represents a specific ending in the list of endings on the attached data sheet.
- The final result between the players will be based on order of arrival and correctly answering about colliding or being observed.

Good luck on the race!

MILESTONES

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.

TYPE

1. **TYPE S**
17% of all asteroids, the second most common type. These are bright and rocky and are made up of Silicon (Si), Iron (Fe) and Sulfur (S).

2. **TYPE C**
These represent 75% of known asteroids and are very dark because they are primarily made up of Carbon (C).

3. **TYPE CM**
Carbonaceous Chondrites, a very uncommon type of rock. These contain remains of water, amino acids and other organic elements.

4. **TYPE M**
These are the brightest and are made of metal, such as Nickel (Ni) and Iron (Fe) and other precious metals such as Platinum (Pt) and Gold (Au).

5. **TYPE D**
These reflect little light and their mostly spectral aspect gives them a reddish hue. It is believed that they have a high carbonate silicate content.

6. **TYPE V**
A rare group such as the Vesta asteroid (3rd most important on the Asteroid Belt), similar to type S but with more peroxides in their creation (more Oxygen links).

TEXTURES

1. **SMOOTH**
Smooth and slippery.

2. **RUBBLE CUMULUS**
Joined by gravity like a series of mud balls.

3. **ROCKY**
With multiple vertices and faces like common stones.

4. **DOUBLE**
Two asteroids that were slowly drawn together and now orbit together in the same space.

5. **CHONDRULES**
Remains of different colored rocks that form a single body.

6. **POROUS**
Full of holes, like a sponge, produced by previous impacts. Similar to the surface of the Moon.

HAZARD LEVEL

1. **NEAR AND INOFFENSIVE**
Your diameter is small like a tennis ball. If you touch the Earth's atmosphere, you will disintegrate.

2. **FAR AND INOFFENSIVE**
You may be big like a city, but you orbit far from the Earth and you are unlikely to come close to Earth.

3. **HUGE AND INOFFENSIVE**
Your diameter is 948 kilometers, like the dwarf planet Ceres. However, your orbit is far from Earth.

4. **MEDIUM HAZARD**
You measure less than 140 meters in diameter but you are 8 million kilometers from Earth.

5. **POTENTIAL HAZARD**
You measure more than 140 meters in diameter and you are less than 8 million kilometers from Earth.

6. **HIGH HAZARD**
You are enormous and your orbit is hard to predict, because you are very far away and not very bright.

CENTER

1. **GOLD**
A single asteroid may contain more gold than all the gold on Earth.

2. **WATER**
This is the most sought-after element, which is more valuable than any other.

3. **PLATINUM**
This is a very rare and very expensive precious metal that is used in the aerospace industry.

4. **FIRE**
A burning, incandescent core resulting from the combustion of many heavy metals.

5. **IRON**
This is not so valuable but it is a metal commonly used on Earth.

6. **ICE**
Cold core like dry ice, which is solid Carbon Dioxide.

FINAL ORBIT

1. **COLLIDED**
You enter the Earth's atmosphere and fall into the ocean. If you are inoffensive, you wreak no havoc. If you are hazardous, you cause tidal waves in nearby oceans.

2. **OBSERVED**
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!

3. **COLLIDED**
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.

4. **OBSERVED**
ALMA successfully identified you, you are part of the Chilean asteroid registry.

5. **COLLIDED**
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.

6. **OBSERVED**
If you are inoffensive, you enter the asteroid registry. If you are hazardous, the planetary protection mission launches a missile to divert you.

TRAPS

T1 You lose your next turn.

T2 The next player loses 1 turn.

T3 You move back 1 square.

T4 The previous player moves forward 1 square.

T5 The game changes direction.

T6 All players move forward 1 square except you.

SUPERPOWERS

★ 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.

QUESTIONS

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

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

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

4 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

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

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

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

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

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

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

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

12 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

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

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

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

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

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

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

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

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

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

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

ANSWERS

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;

DATA

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 60° 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.

35) Studies show that the site where the asteroid fell, which may have wiped out the dinosaurs and the 60° angle with which it fell were extremely precise in provoking the "nuclear winter," because the level of impact caused would not have been the same if it had hit Earth vertically or fallen into the sea.

36) There are no asteroids registered that present a threat to Earth for the next 100 years, but prevention is the best way to protect ourselves.

37) The initial DART (Double Asteroid Redirection Test) mission aims to impact an asteroid named Dimorphos to test the first space defense mission.

38) An asteroid is considered close to Earth when its orbit brings it within 50 million kilometers of our planet.

39) NASA classifies any object more than 140 meters wide which passed eight million kilometers from Earth as a potentially hazardous asteroid.

40) To protect us from asteroids, we need to identify which ones are dangerous and keep an eye on them.

41) It is hard to observe asteroids because they are made of metal or are very dark, so they produce minimal radiation. ALMA is the perfect tool for observing them and contributing to the mission of detecting them.

42) In February 2021, a meteorite fell on England. It is believed to be a rare species of carbonaceous chondrite, which are rocky objects as old as the Solar System. Because it is so dark, it was hard to find amid the sheep excrement in the field where it fell from the sky.

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 Meteoritical 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), 888 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).

ORIGINAL IDEA

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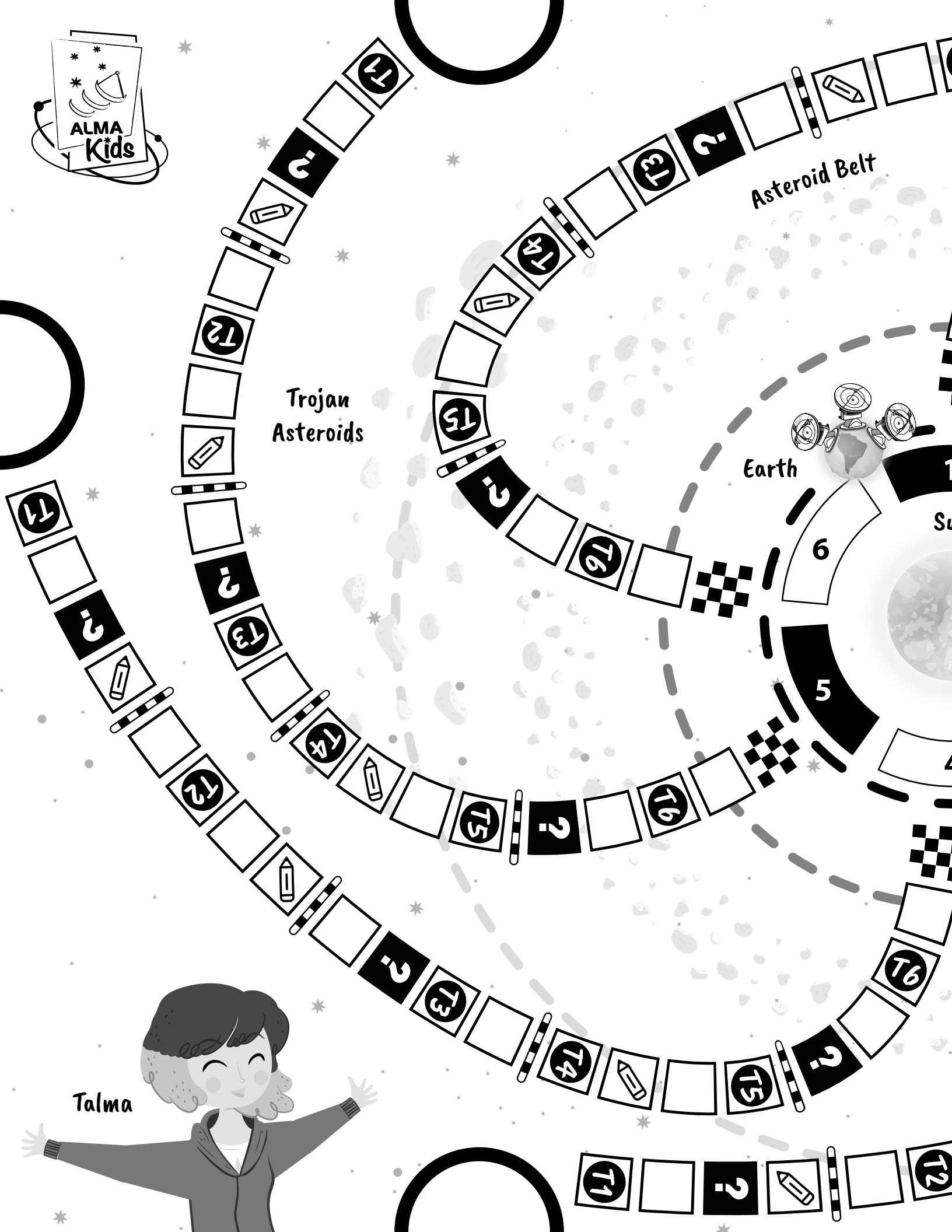
5th International
Asteroid Day commemoration
June 30, 2021


ALMA Kids
Asteroid Belt
Trojan Asteroids
Earth
Talma

Orbit of Earth

Orbit of Mars

Orbit of Jupiter

Mathias

Jupiter

Trojan Asteroids

Mars

Asteroid Belt

Goal

Milestones

Data

Traps

Questions

Drawings