



astrobiogenesis!

build | survive | evolve



overview

Greetings, sentient creature! Welcome to the game of habitability and survival. You'll build a realistic solar system and face catastrophes from comets to supernovae. Life will evolve from germs to animals to sentient, intelligent beings—and if you're lucky, you'll even survive first contact.

players: 2-4

supplies:

- at least one 20-sided die (D20), ideally one per player
- one Planet Sheet per player
- one set of Play Sheets per game

game play:

1. follow the Solar System Construction manual to build a solar system.
2. follow the Play Rules manual to see how your planets fare as time goes on.

Life is a bizarre and beautiful thing. The odds of life arising on a planet depend on not only an astounding number of factors from location in the galaxy to plate tectonics, but quite a bit on luck as well. There are a near-infinite number of ways for this game to play out, and only one way to win. Good luck!

planet sheet

host star type: M K G F A
galactic neighborhood: disk bulge

Planet _____
Type: Earth
HZ: Int. Inside. Ext.

Order in Zone 1
Tidally Locked? N
Moon? _____
Plate Tectonics? _____

20 — [TYPE SCORE] =
 — [HZ SCORE] =
 — [T.L. SCORE] =
 + [MOON SCORE] =
 ± [P.T. SCORE] =

Roll Score

Planet _____
Type: _____
HZ: Int. Inside Ext.

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Tidally Locked? _____
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Roll Score

solar system construction

1. Roll a D20 to decide your star type: 1-15 M star; 16 K star, 17 G star, 18 F star, 19 A star, 20 roll again

2. Roll to determine your location in the galaxy: 1-10 Disk, 11+ Bulge

3. Each player receives two planets. Your first planet is an Earth-mass planet. Roll to determine the class of your second: 1-7 super-Earth, 8-14 sub-Neptune, 15+ Jupiter

4. Roll to determine your location with respect to the Habitable Zone (HZ): 1-10 exterior to HZ, 11-17 HZ, 18+ interior to HZ

5. If there are multiple planets in the HZ zones (interior to, inside, and exterior), roll once for each planet in that zone. Lowest wins. Bigger planet wins a tie. Same mass planets roll again for lowest number.

6. The four innermost planets roll to determine tidal locking status. Planet 1: 3 or below to not lock. Planet 2: 5 or below, Planet 3: 7 or below, Planet 4: 9 or below.

play rules

ROUND 1: Roll to determine your first Catastrophe. Locate the rules for that catastrophe according to your star and planet, and play. The ROLL SCORE (R) and LIFE SCORE (L) for each planet may change. After rolling, fill in the new ROLL SCORE and LIFE SCORE in the Cat 1 column.

Roll to play two more Catastrophes. At the end of the third Catastrophe, the Habitable Zone around your star will change. For M stars, the HZ will shrink; for other types, it will grow outward. Follow the Mobile Habitable Zone (MHZ) rules to see what happens to your solar system.

At the END of the round, roll to see if life arises or evolves. Do this by rolling at the ROLL SCORE or lower. For example, if $R = 13$, you will have to roll a 13 or lower to gain one LIFE point. Roll a 1 to gain 2 LIFE points.

For the final ADD pair of columns, each player gets 1 ROLL point they can add to ANY planet, even if it is not their own, to increase that planet's ROLL SCORE.

ROUND 2, 3, 4: Roll to play three Catastrophes. At the end of the third Catastrophe, if any of your planets have life ($L = 1$ or higher), play through each relevant new LIFE EVENT (i.e. a planet which has gone from $L = 0$ to $L = 2$ will play through a Great Oxidation Event AND a Meteor Impact).

For each incidence of life as it advances, you will only play the LIFE EVENT once. For example, if in Round 2, you have $L = 2$, and then in Round 3, you have $L = 3$, you will only play through the $L = 3$ event (Great Filter). If Level 5 is reached, this immediately triggers the LIFE EVENT: First Contact.

If life loses a level, you will need to repeat LIFE EVENTS as it climbs again.

ROUND 5: At the end of Round 4, you may have Level 4 life, in which case you will roll to see if you survive first contact. If not, you can take a chance by entering a fifth round of play, which could either help or destroy whatever life exists in your solar system.

WIN THE GAME: Achieve LIFE = 5 OR survive First Contact at Level 4

catastrophes

[1 - 5] COMETS: Comets can affect any planet, but solar systems in the bulge are particularly vulnerable to disturbances from passing stars which dislodge comets and send them flying into the planets. First, roll a D20 to decide if an impact is happening.

- BULGE: roll 5 and under to prevent impact
- DISK: roll 8 and under to prevent impact

Planet has life:

- 17-20: LIFE -1, ROLL +2
- 8-16: LIFE +0, and ROLL +1
- 2 - 13: LIFE and ROLL stay the same
- 1: LIFE +1, ROLL -2

Planet does not have life:

- 11-20 ROLL -2
- 2-10 ROLL +3
- 1: LIFE +1, ROLL + 3

[6 - 10] FLARES: Flares impact close-in M star planets on a daily to weekly basis, slowly stripping away atmospheric gases and exposing planets to deadly ultraviolet and X-ray radiation. Flares can also occasionally cause damage to planets orbiting farther out around other stellar types which do not flare as often.

- M star: roll 3 or below to avoid flares
- K G stars: roll a 12 or below to avoid flares
- F A stars: roll 15 or below to avoid flares

Planet has life:

- 15-20: LIFE -1, ROLL +1
- 2-14: LIFE and ROLL do not change
- 1: LIFE +1, ROLL -2

Planet doesn't have life:

- 6-20: ROLL -1
- 2-5: ROLL +1
- 1: LIFE +1 and ROLL +1

[11 - 14] OCEAN ANOXIA: Various biological and geological factors can cause major chemical changes in the oceans of rocky planets, with the potential to alter or destroy ecosystems. All rocky planets and gaseous planets with moons will roll to determine the effects of ocean anoxia.

Planet has life:

- 17-20: LIFE -1, ROLL -1
- 11-17: LIFE +0, ROLL +0
- 2-10: LIFE +0, ROLL -1
- 1: LIFE+1, ROLL -2

Planet doesn't have life:

- 6-20: ROLL -2
- 2-5: ROLL -1
- 1: LIFE +1 and ROLL +1

[15 - 18] SUPERVOLCANO: Planets with plate tectonics often suffer from supervolcano eruptions as continents are born and move around. For ONLY planets with plate tectonics:

- 18-20: take ALL points from LIFE, ROLL+2
- 10-17: LIFE-1, ROLL+1
- 4-9: LIFE +0, ROLL -1
- 1 - 3: LIFE +0, ROLL +3

[19 - 20] SUPERNOVA: a nearby supernova could exterminate life on a planet, an outcome far more likely in the galactic bulge, where nearby stars are much closer than in the disk.

- BULGE: Roll 3 or less to avoid the supernova
- DISK: Roll 12 or less to avoid the supernova

All planets:

- 18-20: lose all LIFE points, ROLL - 3
- 10-17 LIFE -1, ROLL - 2
- 2 - 9: LIFE +0, ROLL - 1
- 1: LIFE +2, ROLL +0

MOBILE HABITABLE ZONE:

- M star gets cooler (one IHZ → HZ, one HZ → EHZ):
 - Outermost IHZ planet R +12; O.M. HZ planet R -4
- K G F A star get hotter (one HZ → IHZ, one EHZ → HZ):
 - Innermost EHZ planet R+4; I.M. HZ R - 12

life events

[LEVEL 1] GREAT OXIDATION EVENT: A dramatic change in the atmosphere induced by a new kind of oxygen-producing photosynthesis 2.5 billion years ago wiped out 99% of life on Earth but allowed for the evolution of new organisms which used oxygen to function. How will your planet fare?

- 20: LIFE - 1 ROLL - 3
- 6-19: LIFE +0, ROLL +2
- 1-5: LIFE+1, ROLL +2

[LEVEL 2] METEOR IMPACT: Like a comet, but without the amino acids. An event like the dinosaur-killing Chicxulub Impactor could wipe out all life... or give the ecosystem the big change it needs to produce sentience.

- 18-20: LIFE - 1, ROLL - 1
- 4-17: LIFE +0, ROLL +3
- 1-3: LIFE+1, ROLL +3

[LEVEL 3] GREAT FILTER: Earth's sentient (but dubiously intelligent) life is currently wrestling with major threats such as climate change, nuclear war, and widespread pandemics. Let's see how your sentience handles a Great Filter.

- 18-20: LIFE -1, ROLL+3
- 4-17: LIFE +0, ROLL -3
- 1 - 3: LIFE +1 ROLL +0

[LEVEL 4] FIRST CONTACT: Contact with another sentient, technological civilization could result in galactic collaboration or the utter destruction of an entire solar system. If another planet achieves more life in this process, go through the relevant LIFE EVENTS.

- 20: All life in solar system exterminated
- 19: Lose all LIFE points on planet
- 18: LIFE -3
- 17: LIFE -2
- 16: LIFE -1
- 15: LIFE +0
- 10-14: LIFE +0, choose one other planet to add 1 LIFE point to
- 5-9: LIFE+0, choose one other planet to add 2 LIFE points to
- 1-4: LIFE +1, first contact achieved, YOU WIN THE GAME

glossary

ANOXIA: a state of water in which there is very little oxygen content which kills marine life here on Earth; on other planets, any kind of sudden depletion of an important chemical could cause the same effect.

COMET: a celestial ball of ice, dust, and important molecules necessary for life known as “amino acids”. Comets were believed to be one source of amino acids here on Earth.

FIRST CONTACT: If there are other intelligent, technological civilizations out there in the galaxy, we might one day encounter them—an interaction which could go either very well or very poorly for humanity.

FLARE: a burst of high-energy radiation from a star which can harm living creatures and strip away materials from a planet’s atmosphere.

GALACTIC DISK/BULGE: We live in a spiral shaped galaxy with a big, dense clump of stars at the center called the “Bulge”. The part with the spiral arms coming out of the Bulge is called the “Disk”.

GREAT FILTER: A great filter is a barrier that all intelligent civilizations would face as they evolve technologically. Climate change, nuclear war, and pandemics are three relevant challenges we face today.

GREAT OXIDATION EVENT: 2.5 billion years ago, rudimentary photosynthesis evolved to produce oxygen, flooding the Earth's atmosphere with a gas that its microbial life was not adapted to using. Nearly everything died except for the small percentage of life that was able to quickly adapt. Today, a vast majority of living creatures rely on oxygen.

HABITABLE ZONE: The range of distances from a star in which liquid water can exist. It is hard for life to form in an environment above 100° C, because there aren't any suitable liquids, but perhaps easier for life to form in a colder environment, in a medium such as liquid ammonia, methane, or ethane.

HABITABILITY: the capacity of a planet to maintain an environment suitable for life.

METEOR IMPACT: 66 million years ago, an asteroid 6 miles across slammed into the Yucatan Peninsula and changed the path of evolution forever. Cold-blooded dinosaurs went extinct, allowing for the rise of mammals and eventually humans.

MOON: The moon plays two important role in the evolution of life: it creates an ideal wet-dry cycle for life to begin, and its early magnetic field protected the young Earth's atmosphere from solar radiation.

PLANET TYPES: Planets can be small and rocky (Earths), large and rocky (super-Earths), small and gaseous (sub-Neptunes), or large and gaseous (Jupiters).

PLATE TECTONICS: The Earth's crust is broken into many tectonics plates. The motion of these tectonics plates as they slide over one another removes carbon dioxide from the atmosphere. Carbon dioxide is absorbed by rocks and water on the plates, and when they are returned to the mantle, the gas is buried with it.

SENTIENT: able to experience sensations and feelings in a conscientious way; humans are sentient, but animals are not.

STAR TYPES: Stars are organized by their size, with small stars being more common, but not very good planet hosts. 75% of all stars are small (Type M), with K, G, F, and A types being increasingly larger.

SUPERNOVA: the explosive death of a massive star which generates extreme amounts of high-energy radiation. This radiation can have significant impacts on stars which are nearby. Supernova are more likely to impact planets in the Bulge of the galaxy.

SUPERVOLCANO: an eruption of a sizeable percentage of the planet's surface which changes the composition of the planet's atmosphere and raises or lowers global temperatures.

TIDAL LOCKING: When a celestial body orbits another, and the smaller body is always facing the larger, they are tidally locked. The moon is tidally locked to the Earth, so we see the same face all the time.

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