Biota Rules

# Objective of the game

Players attempt to fill the playing area with organisms from their team that outcompete rival teams. A player is assigned a color for their organisms and this is referred to as a haplogroup. All descendent organisms of that haplogroup will be of the same color. Therefore, the player is trying to fill the board with organisms of their designated color.

Winning conditions may vary from board to board. They might include the first to reach a certain number of organisms (generally referred to as biomass for the haplogroup) or they may be tasked with completely wiping out all opposing haplogroups, or some other variation.

All winning conditions will be predicated on the idea of adaptation, mutation, and evolution, in order to create a more robust biological solution for increasing population.

# Player Basics

Each player will be awarded a given number of starting biomass points with which they can place the most basic of organisms (biota). These biotas will feed, grow, and reproduce. The player has no direct control over the biotas; none. What they do have control over is environmental conditions and the placing of new biotas.

Each tick of the game clock awards the player additional biomass points. The number of points earned is based on the collective biomass and relative health of the haplogroup. These points can be used for various actions that will include the following:

* Placing additional Biota
* Gather/Remove existing Biota from the board
* Raise/Lower terrain
* Initiate Precipitation
* Initiate Radiation/Drying/Sunlight
* Construct/Drop BioBombs
* Genetic Manipulation

Some actions will be much more expensive than others in order to maintain a sense of balance throughout game play.

# Biota Basics

Each of the Biotas on the board will live a simple life of feeding, growing, and reproducing. Biota that feed effectively will accumulate enough reserve biomass points that they will reproduce through basic mitosis. An isolated biota in a landscape with sufficient food and few hazards can quickly fill that landscape exponentially.

Impediments to unchecked growth include the lack of resources/food, the lack of available space to grow into, and the competition for resources and space with individuals from other haplogroups. This competition will drive natural selection of the Biotas that are the most well adapted for prevailing conditions within the biome and at specific locations in it. Adaptations/Mutations can occur during reproduction.

When a Biota splits into two, one will remain as is (the parent) while the other (the child) has a chance of incorporating one or more mutations. Mutations may provide beneficial attributes and they may not. What determines whether or not those attributes are beneficial is the environment. A mutation that allows the biota to consume more food more quickly may help it outcompete rivals in its local area. But that same mutation may cause the biota to starve more quickly if food becomes scarce.

All feeding will initially be from a universal nutrient…some generic poly-organo-goo that provides sustenance to all Biotas. This self-renewing substance will be found in varying degrees of abundance throughout the biome.

In future iterations of this game, the food stuffs will likely be differentiated into the four types such as (a) Universal Poly-Organo-Goo, (b) Pre-Biotic Compounds, (c) Carbo-Organic Compounds, and (d) Protein Compounds. The exploitation of these different food stuffs will only be possible after appropriate mutation/evolution, hopefully lending a lot more nuance to the game.

While it’s important to understand how each individual biota functions, it’s also critical to grasp the fundamentals of the Communities. Communities are contiguous areas of common haplogroup biotas. These communities provide benefits to their members in one very significant way: A community provides additional nutrients to its members. Nutrients gathered by interior biota are transported to adjacent biota for their use. This is done for the simple reason that interior biota cannot reproduce into an adjacent cell because they are all occupied. It therefore provides those resources to its neighbors.

This resource sharing has implications in the areas of reproduction and in recuperation. Consider the rapidity with which a community can expand given that it can collectively provide the biota on the perimeter with enough resources to reproduce more quickly. Likewise, exterior biota who are damaged from encounters with predators or rivals can heal more quickly.



## Data Dictionary

Entity: Biota

|  |  |  |  |
| --- | --- | --- | --- |
| **Column** | **Purpose** | **Mutable** | **Influence** |
| Biota\_Id | Unique id for each individual organism on the playing surface or stored in the gene lab | N | n/a |
| Model\_Id | Potentially used to identify the 3d Mesh used to render this individual | N | n/a |
| Color\_Code | The identification of the original team that this organism belongs to. I saw original thinking that in the future, there may be a situation where an team is taken over by another player, but would still retain its original color | N | n/a |
| GeoCell\_Id | This is the location of the individual on the playing surface | N | n/a |
| Cycle\_Id | Which of the cycles of evaluation the individual is in. | N | n/a |
| Base\_Value | This represents the most basic Biomass point value of the individual. It is a function of the various different traits that it has and how much those cost to maintain, etc. Other functions are based on this value. | N | n/a |
| Health\_Value | A reflection of the current Health of the individual. At its best, it is equal to the base value, and would indicate that the individual is free of injury. | N | n/a |
| Subsistence\_Value | This value indicates how many biomass points must be consumed by the individual in order to survive each round. It is a function of many factors, but should roughly be considered to be 5% of the base value. | N | n/a |
| Reserve\_Value | This value indicates how many biomass points the individual organism has in reserve or excess storage. These can accumulate each turn that the individual consumes more than its minimum (subsistence) number of points. Its maximum value is equal to the base value at a minimum, but may be greater…giving the individual additional points to draw from for healing as well as spawning. | Y | Direct |
| Exterior\_Value | A rating regarding the exterior of the individual. Initially there is no “exterior” other than skin and it has a value of 0. But shells, hides, hair, and other exterior types will require additional biomass points to maintain even though they may confer environmental advantages. It also indicates how much attack damage may be absorbed by the exterior. | Y | Direct |
| Exterior\_Type\_Cd | An indicator of what type of exterior the individual has acquired genetically. It might include one of Skin, Shell, Hide, Hair, Fur, Spikes, Slime, etc. | Y | 0 Points |
| Reflex\_Damange\_Value | When attacked, an organism may have a reflexive response due to the nature of its exterior. This value represents how much reflexive damage is potentially caused to the attacker. | Y | Direct |
| Arm\_Count | This will be a value of 0, 1, 3, or 6. Arms allow individuals to perform different actions dependent on the type of arm involved. | Y | Direct |
| Arm\_Length\_Value | An indicator of how far the arm of the organism can reach/influence. All arms will be considered the same length on an individual. Arms will be of length 0, 1, or 2. | Y | Direct |
| Arm\_Type\_Cd | An indicator regarding the type of arm (all arms are the same) that an organism has. This might be one of pseudo pod, tentacle, hook, claw, point, etc., some of which are valueable for attacking and/or gathering food. | Y | Direct |
| Leg\_Count | Legs are similar to arms and will come in quantities of 0, 2, 4, or 6. Legs provide no real advantage at this time. In the future, they may provide locomotion or defensive value. | Y | Direct |
| Leg\_Type\_Cd | The type of leg (all legs are the same) that an organism has. This might be one of pseudo pod, tentacle, hoof, flipper, pad, etc. | Y | Direct |
| Eye\_Count | The number of eyes that an individual has. Sight will confer benefits with feeding and fighting. An individual may have 0, 1, 3, or 6 eyes. | Y | Direct |
| Eye\_Type\_Cd | The type of eye (all eyes will be the same) the individual has. It might be one of obscura, …. | Y | Direct |
| Ear\_Count | The number of ears that an individual has. Hearing will confer benefits with feeding and fighting. An individual may have 0, 1, or 3 ears. | Y | Direct |
| Ear\_Type\_Cd | The type of ear (all ears will be the same) the organism possesses. It might be on of membrane, trumpet, … | Y | Direct |
| Feed\_Sequence\_Cd | A string of characters indicate the feeding preferences for the organism. | Y | None |
| Feed\_Sequence\_Current | The current value indicating from where the individual is focus on feeding. | N | n/a |
| Feed\_Max\_Rate\_Value | The maximum biomass points that the individual can consume per tick. | Y | Direct |
| Feed\_Buffer\_Value |  |  |  |
| Spawn\_Sequence\_Cd | A string of characters to indicate the hex that the individual will use for spawning offspring, if appropriate/required | Y | None |
| Spawn\_Sequence\_Current | The current value indicating where the spawn will next occur | N | n/a |
| Spawn\_Min\_Wait\_Value | The minimum number of ticks that must transpire between spawnings. | Y | Inverse |
| Max\_Heal\_Rate\_Value | The maximum rate of healing that can occur during a tick (assuming there are reserve points to be used for healing). | Y | Direct |
| Attack\_Sequence\_Cd | If the individual has an option for attacking, this is the string of characters that represents where the individual will attack; its preference. | Y | None |
| Attack\_Sequence\_Current | The current place in the attack sequence. | N | n/a |
| Attack\_Damage\_Value | The maximum damage that the individual can inflict on a victim. | Y | Direct |
| Attack\_Rate\_Value | The minimum number of ticks between attacks. | Y | Inverse |

# Processing and Evaluation of the Biome

**Tick:** The basic unit of game time wherein actions are performed.

**Turn**: The turn is a cycle through the different phases of biota individual actions; Attacking, Feeding, Spawning, and Resting.

**Phase:** The different action cycles of the individual.

Each tick of the game clock requires the evaluation of each cell of the landscape for many purposes, including awarding biomass points. While the cells themselves do not have different “stages” or “cycles”, the biotas themselves do, and tracking this is very important.

A biota goes through different stages in a given cycle of evaluation; attacking, feeding, reproducing, and resting. The “clock” of any given biota is established when it is born or placed on the landscape. In this respect, there won’t be obvious ticks where all biotas are fighting, then feeding, etc. Each marches to its own cycle. Any stage of the cycle that is irrelevant, is skipped. That is, if a biota is incapable of attacking, it proceeds immediately to the feeding stage. Likewise, if the biota does not yet have enough reserve biomass to reproduce, then that stage is skipped in favor of the next applicable stage. However, feeding can only happen once every 3 ticks, so in many cases, the biotas will simply rest for a

Consequently, the beginning of the game will see a lot of biota simply feeding each tick of the game clock until some start reproducing, or encounters with rivals and environmental stresses start imposing on the individuals.

## GeoCell Evaluation

With the initial iteration of the game, the expectation is that the evaluation of the GeoCell (a single unit of landscape) will simply be the addition of more nutrients, up to the maximum capacity for the GeoCell (assuming nothing is feeding from it). This is the basic renewal of resources that is a fundamental part of the game.

Each GeoCell will have a current generic nutrient value representing how much “food” is available for the occupying or surrounding biotas to feed on. Each GeoCell also has a maximum generic nutrient value where the accumulation of nutrients is capped, since it would make no senses for unoccupied cells to simply generate an infinite pile of nutrients available to the first biota that can access it. Lastly, the GeoCell has a renewal rate attribute that indicates how quickly nutrients are renewed on the GeoCell and available to the biota.

New Nutrient Available =

CASE

WHEN GeoCell.Nutrient\_Value > GeoCell.Nutrient\_Max\_Value

THEN GREATEST(GeoCell.Nutrient\_Value – GeoCell.Nutrient\_Renewal\_Value,

GeoCell.Nutrient\_Max\_Value)

ELSE LEAST(GeoCell.Nutrient\_Value + GeoCell.Nutrient\_Renewal\_Value,GeoCell.Nutrient\_Max\_Value)

END

In further iterations of the game, it is expected that additional attributes of the GeoCell will be tracked. This would likely include temperature, altitude, type of atmosphere, etc. These factors will be evaluated in later iterations of the game, if any.

## Biota Evaluation

Each Biota will be reviewed once per clock tick in the game world. Each will be in a given phase of the turn of evaluation. As mentioned, these are attacking, feeding, resting, and spawning, and only those that are relevant will be considered.

Processing is performed in this manner:

1. Evaluate the survival of the individual; have they died due to injury or starvation
2. Perform Phase Action dependent on the individual’s current phase
   1. Attack – Lash out at rival individuals in the vicinity
   2. Feed – Gather nutrients from the environment
   3. Reproduce – Spawn offspring in adjacent hexes
   4. Rest – Heal or otherwise recuperate

### Suvival

As part of the evaluation, we need to know if the Biota will or has survived the turn. To do so, the Individual must satisfy the following criteria.

1. It must be able to collect enough Bio points to maintain itself/feed (the subsistence points). These can be drawn from the environment or from its own reserve points.
2. It must maintain a Health Value of at least 25% of its Base Value. Injuries, attacks, etc. may do enough damage to kill the individual.

Feeding

Feeding is the collection/consumption of nutrients. An individual can draw from a variety of sources in order to earn enough subsistence points each tick. This may include the simple consumption of nutrients on the occupied hex, nutrients collected from “reachable” adjacent hexes, or nutrients supplied by neighbors (see Community benefits).

Each Individual has a Maximum Feeding Rate. This is the absolutely highest number of Bio points that can be consumed per tick, even if there is an abundance of nutrients available. The organism just cannot consume more than this. However, the Maximum Feed Rate is a **Mutable Trait.** In successive generations, this value may be altered. This trait’s value has a directly proportional impact on **Base Value**.

While Healing draws from the Reserve Points, the Reserve Points are only renewed when the individual consumes more than the subsistence value.

### Feeding, Gathering Nutrients

The number of nutrient points that can be gathered by a single biota during a single tick is determined by a few factors.

* Availability, meaning the number of nutrients available in those reachable GeoCells
* Reach, meaning which of the home and adjacent GeoCells an individual can gather from.
* Order Preference, meaning which GeoCell a biota will pull from during a given clock tick
* Competition, meaning who else is feeding from the same GeoCell, friend or foe
* Community, the resources available or supplied by community connections

**Availability** is simply the number of available nutrients in a GeoCell. These are spontaneously generated and renewed and represent the basic foodstuff in the first iteration of the game. This is described in more detail above in the GeoCell Evaluation topic.

**Reach** is determined by the number and length of appropriate limb types. Initially, a biota has no limbs and cannot reach any GeoCells other than its home GeoCell; the one it is sitting on. If the biota does develop limbs, the initial reach (if they are of the appropriate type) is only 1, so that the biota can feed from adjacent GeoCells and its home GeoCell only. But some biota may develop longer limbs that can reach the next ring of GeoCells, in which case it can actually draw from 18 GeoCells to feed itself.

**Order Preference** means which of the reachable cells the biota will next attempt to feed from, in addition to the home GeoCell that the biota rests on. The order is determined by a string of characters (of appropriate length regarding the up to 18 cells that might be reachable) indicating the order of GeoCells considered. If the GeoCell being fed from is occupied, the amount of nutrients gathered is reduced.

**Competition** is a measure of how many other biotas are attempting feed from the same GeoCell. Even the home GeoCell is not a secured food source and is susceptible to competition. Competitors may reduce the amount of available nutrients from a given GeoCell.

**Community** represents the number of “buffer” nutrients available from adjacent interior family members. If the biota is not at its maximum value for Health, Reserve, and Buffer, and there is available Buffer Nutrients from adjacent family members, the buffer points will be drawn off, but it cannot (combined with the other nutrients gathered) exceed the maximum feeding rate.

Nutrients Gathered =

1. LEAST(Home.GeoCell.Nutrient\_Value,Biota.Feed\_Max\_Rate)
2. [Reduce Home.GeoCell.Nutrient\_Value]
3. (LEAST(Adj.GeoCell.Nutrient\_Value,(Biota.Feed\_Max\_Rate-[Value 1 Above])/(Adj.Occupant\_Count \* 2))/Adj.Distance
4. [Reduce Adj.GeoCell.Nutrient\_Value]
5. (LEAST(Comm.GeoCell.Buffer\_Value,Biota.Feed\_Max\_Rate – [Value 1 Above + Value 3 Above])

Buffer Value = Nutrients Gathered – Biota.Subsistence\_Value

WHEN Biota.Health\_Value < Biota.Base\_Value THEN Biota.Health\_Value = Biota.Health\_Value + LEAST(Biota.Buffer\_Value,Biota.Heal\_Max\_Rate\_Value,Biota.Base\_Value – Biota.Health\_Value)

Biota.Buffer\_Value is reduced by points moved to Health.

WHEN Biota.Reserve\_Value < Biota.Base\_Value THEN Biota.Reserve\_Value = Biota.Reserve\_Value + LEAST(Biota.Buffer\_Value,Biota.Base\_Value-Biota.Reserve\_Value)

Biota.Buffer\_Value is reduced by points moved to Reserve

This value is immediately removed from the balance of available nutrients in the GeoCell so that they cannot be double consumed by neighbors and the Biota on the GeoCell.

### Resting/Healing

An individual whose health is less than their base value can draw on reserve points to heal. Reserve points can only be transferred to health at up to the maximum heal rate. The maximum healing rate is a **Mutable Trait.** The higher the value of this trait the more points it takes to maintain.

Mortally wounded individuals are those whose health value is below 25% of the Base Value for the individual. They will not heal sufficiently and instead will do one of two things during its turn.

1. It will spawn, assuming it has enough reserve points to do so. This is a priority.
2. It will transfer as much of its reserve points to its neighbors as it possibly can, that transfer being limited to the maximum feed rate.

### Attacking

In this phase, those biotas that are capable and have available targets, will initiate an attack on a neighbor of a rival haplogroup. The biota may initiate 1 attack for every 3 attacking limbs it possesses. So, a biota with 6 arms may attack two different neighbors during this phase.

Attacks may or may not be successful. The base likelihood of success on any attack is 25%. The chance of success may be increased for biota that have eyes. For each eye, the chance of success increases 25% up to a maximum of 100% for 3 eyes.

Attack damage is only accessed if the attack is successful. In this case, the damage done is a random value between 1 and the maximum damage that can be done by the limb.

Reflex damage is assessed to the attacker if the attack is successful and the victim has defensive damage capabilities. These would include spikes, spiked shells, toxins, grappling, etc. Reflex damage is a random value from 1 to the maximum value of reflex damage.

Damage is subtracted from the Health Value attribute of the biota. If the Health Value reaches 0, the biota dies, leaving behind additional nutrients. The nutrients left behind will be equivalent to the deceased’s Reserve Points and 10% of the Base Points, which are added to the GeoCells nutrients count. When initially deposited, the nutrient value on the GeoCell may exceed the GeoCell’s maximum. Each subsequent tick will reduce the nutrient value by the GeoCell’s renewal rate until such time as it returns to a value at or below the maximum allowed on the GeoCell. This is included in the expression shown above.

### Resting

The resting phase of the biota’s cycle marks a period of no outward activity within the cycle. This serves two purposes: (A) It slows the mad frenzy of feeding that is the initial state of the biota, (B) It provides the biota with an opportunity to heal any damage it has suffered.

If the Biota is healed (Health\_Value = Base\_Value), then nothing is done during this clock tick. The biota simply exists.

If the Biota is not healed, buffer points (as calculated during feeding) may be drawn upon to rebuild the health of the biota, within limits as defined by the maximum rate of healing.

### Reproducing

This phase represents the biota’s chance to spawn children. If the biota has accumulated enough reserve points to equal the base value, then the biota has enough reserve biomass to spawn a child. That child will be born in a vacant adjacent GeoCell. The cell chosen will be determined by the first available in the spawn sequence code.

If no vacant GeoCell is available, the biota will do nothing during this phase, as it is effectively an interior community member at this point, and is therefore gathering nutrients for the sole purpose of passing them on to adjacent family members.

### Reproduction, Mutation

When it is determined that an individual will spawn offspring, then it must be determined if any mutations will be realized in the new individual. While we won’t initially define the “genome” of the biota, the point is that we’ve identified which attributes of the creature are mutable, those that can be changed rather than those that represent status or attributes regarding position in the world.

Until we have a working prototype, we won’t know specifically which rates of mutation are appropriate to make the game fun. We will have to adjust these things as we go on, and we will likely want to make them different for the various maps.

A **Basic mutation rate** should be used to indicate whether a spawning includes mutation. Initially this value should be pretty low. I would expect organisms to go at least 10 generations without any appreciable changes. A random value is generated to determine if ANY mutation occurs. If there is a mutation, then we need to consider what that mutation is.

**Value Mutations** are incremental and do not require as significant a change as **Morphology Mutations**, which involve the addition of limbs or other major changes to structure.

A random value should be generated that indicates the number of mutation points that are to be applied. This value should be from 1 to 3, where MOST of the time it is a 1, OCCASIONALLY a 2, and RARELY a 3. These points will be distributed across the mutable attributes of the organism, but the value will randomly be positive or negative. The individual points will be added to the values of those attributes.

This is all we need to do for **Value Mutations**, but **Morphology Changes** will require another degree of change, because it shouldn’t be that simple for whole structures to be added. Because of this we will use the “Type Codes” as a sort of punctuated progressive value. In this case, a “point” of mutation is actually added to the Type Cd, but a value of 0-3 (perhaps) represents no change. Whereas a value of 4 (for instance) might represent the formation of an Eye (or whatever organ it is), Therefore the Type Code reference values are very important in determining whether something has been realized or not, and of what type.

[tables of type codes need to be developed]

Exterior Type

Skin

Hide

Shell

Hair

Fur

Feather

Spike

Spiked Shell

Eye Type

None

Light Sensitive Patch

Pinhole/Obscura

Compound

Focusing Lens

Ear Type

None

Membrane

Trumpet

Directional

Arm Type

Pseudo Pod

Tentacle/Flagella

Point

Claw

Manipulator

Leg Type

Pseudo Pod

Tentacle

Pad

Hoof

Foot

# World Generation