

Bug Juice Inc.

A competitive resource management game about bugs, industry, and capitalism.

Ben Bouvy, Jonathan Luke, Andrew Quintanilla, Tyler Samay, Xander Tooze
The Better Bug Bureau



From left to right: Ben Bouvy, Jonathan Luke, Andrew Quintanilla, Tyler Samay, Xander Tooze

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Game Design

Summary

In Bug Juice Inc., a bug-themed strategy game, players choose one of four major insect companies in a backyard: the Mantid Corporation, the Beetle Brothers, the Leafcutter Collective, or the Bureau of Bees. Each corporation has their own unique abilities and starting locations. These companies are represented by small standing armies of insects that comb the yard in search of resources to fuel their growing juice empire. Players race to be the first to produce and ship juice by using three different resources and challenging other players in combat. The first player to make three Juice shipments wins the game.

History, Antecedents and Related Games

We took inspiration from the following games:

- Catan: Resource Management
- Monopoly: Management of property building.
- Risk: Dice rolling themed combat.
- Civ: Mandatory movement of trader units each turn.
- Polytopia: Simplicity in running a nation.
- Bug Fables/Hollow Knight: Insect hierarchy inspiration
- Grounded: Insect abilities

Gameplay

The core mechanics of the game are building factories, manufacturing and shipping Bug Juice, and trading with and/or crushing the competition through battles against other players, rolling dice against each other, for both land and juice alike. Throughout the game, factories built on Resource Hexes will net players one of three resources: Dung, Fiber, or Honey, which can be used to create the mixture for Bug Juice and ship Bug Juice via hired delivery bees, or Beelancers. The destination for each juice shipment is Sandbox City, located at the center of the board, which will net your company a point for each shipment of Juice delivered. The end goal of the game is to deliver the most Bug Juice out of all of the other companies, either through being the first to 3 or after a set turn limit. There are 4 corporations with the following abilities unique to each:

- **Mantid Corporation (Nest: The Twiggy Shrubbery):**
 - The Mantid Corporation has one extra Soldier and goes first at the beginning of the game
- **Beetle Brothers (Nest: The Rotted Log):**
 - The Beetle Brothers can produce Bug Juice with one Dung and two Fiber **OR** two Dung and one Fiber.
- **Bureau of Bees (Nest: The Royal Hive):**
 - The Bureau of Bees gains two Honey at each Factory on an Old Hive Hex.
- **Leafcutter Collective (Nest: The Ancient Hill):**

- The Leafcutter Collective can send out Beelancers with one Honey **OR** two Fiber.

Players will have to deliver the juice by using a special piece to taxi the Bug Juice into the center hex. These special pieces, beelancers, cannot attack any pieces, but can defend themselves when attacked.

Narrative

The source of supreme insect nourishment is centered around a fast growing industry of a product called Bug Juice. Bug Juice is a cocktail of vital nutrients for all sorts of bugs that is being bought and sold in Sandbox City by the ounce. Looking to have a leg, pincer, horn, or antenna in this race, the four major insect companies of the yard use whichever tools they have at their disposal to worm their way up to the leading brand of bug mixture marketing. The corporations want to edge out the competition and corner the Bug Juice market in Sandbox City. Whoever can establish a customer base by making shipments first will corner the market.

Mood Board:



Technical

Theming

A bug themed capitalistic industrial environment, where you gather and produce resources. Players will make conscious tactical decisions to cut out other players competing much like a capitalist market. Players will produce and ship products and think about shipment routes as well as thinking about potential costs. Players will also indulge the seedier side of capitalism, engaging in fights with other corporations to destroy their workers, factories, and products.

Each of the ideas in the theme reflects the story differently. The decisions to cut out others show in the movement of Soldiers to block out other players from occupying tiles. The shipping routes manifest in how Soldiers are played to protect Beelancers. Players can create a funnel to protect them if they play optimally. Players think about not only the cost of managing their resources, but also the opportunity cost of not acting immediately and letting another player develop a space or ship juice. The seedier side of capitalism comes through in combat, where players can attack other soldiers to send them back to base, destroy other player's factories, and stop shipments of Bug Juice.

Mechanics

Factions - Choosing your faction at the beginning of the game will give you different buffs and options throughout the game.

Soldiers - soldiers are the main way of interacting with the board, players will move them across hexes and set up factories and fight other players.

Combat - Players who move soldiers to the same spot will have to roll dice against each other. The piece already being on that hex being the defender. Defenders will win ties, the loser will move their piece back to their nest. Any adjacent pieces to the attacker will net extra dice rolls, keeping the highest.

Factories - Factories can be put down on empty hexes by soldiers once per turn, when factories are active at the beginning of your turn you will get the resource of the hex it is on.

Resources/Hexes - Every hex that isn't dirt (the brown ones) will give the player the resource that they represent.

Juice Production - Once players have the required resources they can produce bug juice, once per factory.

Delivery - Players will pay 1 honey if there is a bug juice produced and a soldier is on the hex with a factory. Then the player will put away their soldier and factory and place a beelancer piece.

Balance - The key balance of the game is in the map layout. Each player can reach one resource on turn one, and the map is set up so that it is the least valuable resource for that player. The resources are also placed in a way that allows corporations to manage their resources to their abilities, such as putting Honey to the Bees than Beetles.

Resource Management - The importance of resource management comes in the Juice

Production phase. Players must manage their resources accordingly to make sure they not only have the juice available to ship and deliver, but also so that it can be protected on its way to Sandbox City.

Skill and Chance - Almost every aspect of the game can come down to skill. The only chance element is combat. Combat is random, but weighted towards the defender. The attacker wins ~41.5% of all encounters. Players can plan around combat, and weigh the pros and cons and the risk-reward. Players are rewarded for strategic positioning to give them an advantage for combat.

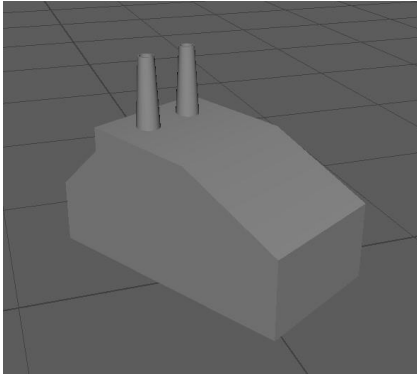
Set Up

The players should remove all the game pieces from the box and arrange the Hexes accordingly with the image provided. Then each player goes to their corner of the map and brings out their three factories (two if Mantid), four soldiers (five if Mantid) and four beelancers. Then the players should move the tokens and organize them by type (Honey, Dung and Fiber) and use these as a bank to pull from. See rules for greater detail.

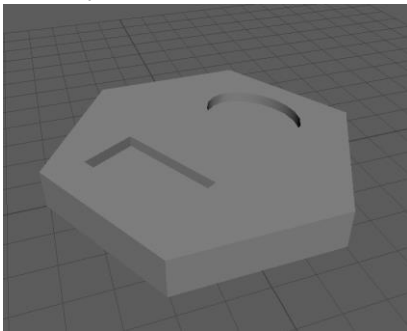
Design

Visual Style

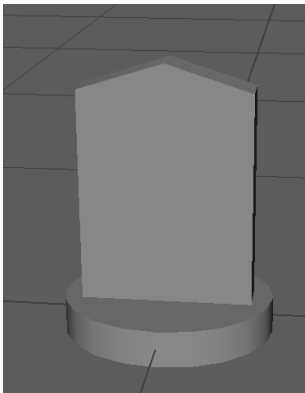
1. Pieces used



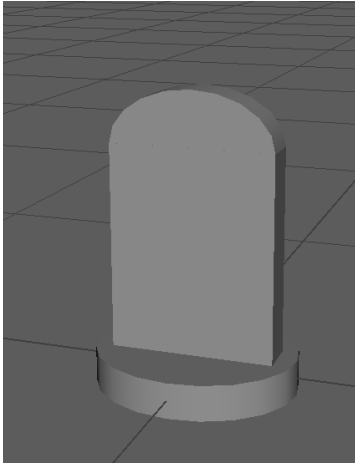
Factory - Xander



Hex Tile - Xander



Soldier Piece - Xander



Beelancer Piece - Xander

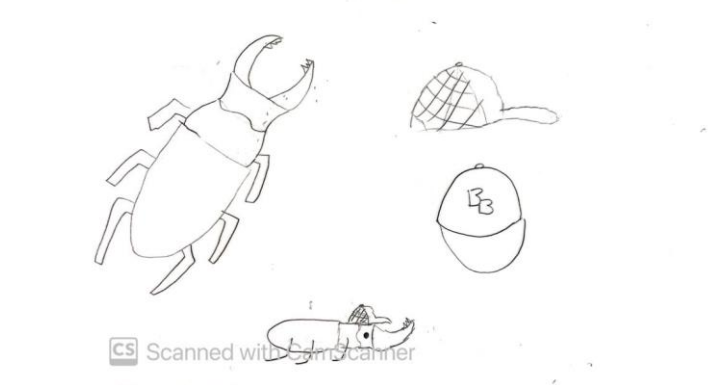


Final symbol art designed by Maggie Griffiths

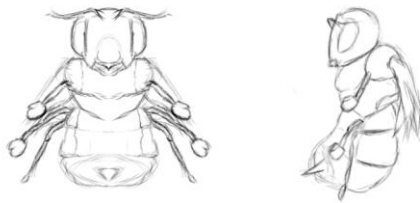
2. Include Images of game set up and mid-play:



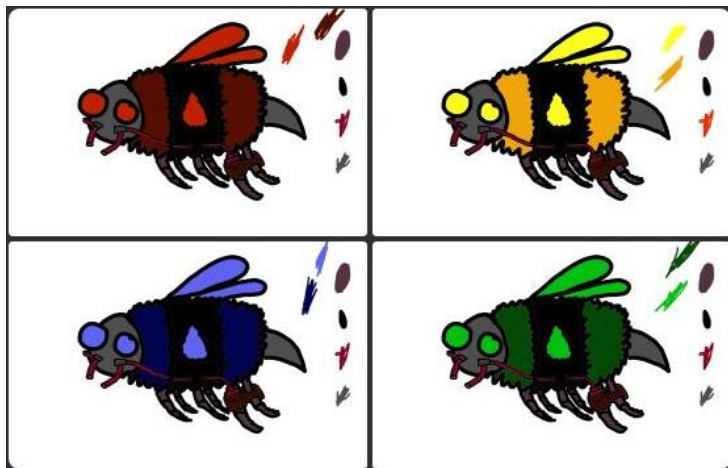
3. Concept art



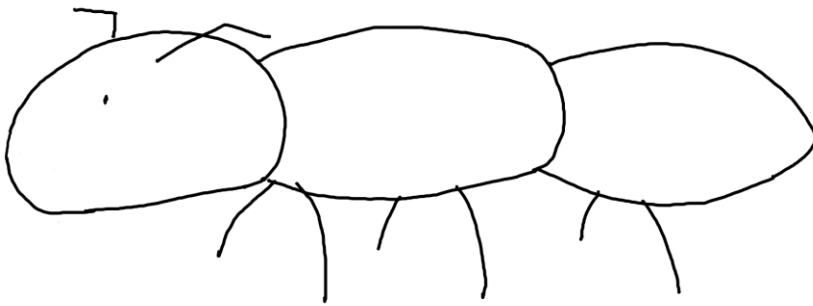
Beetle bro concept art - Xander



Bee concept - Andrew



Beelancer concept - Ben



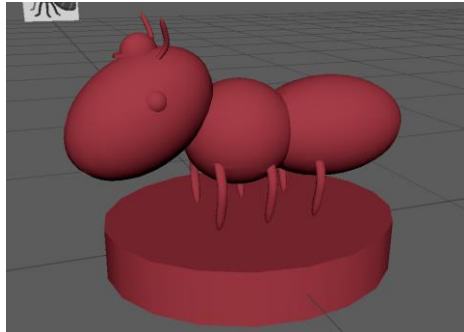
Ant concept - Tyler



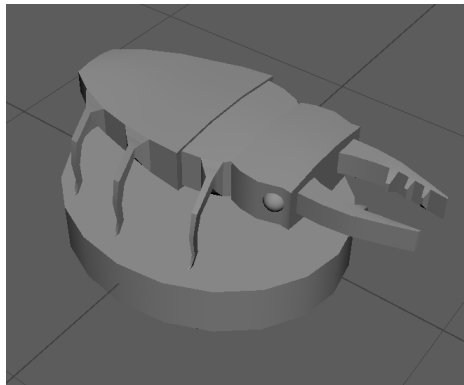
Mantid Concept - Jon



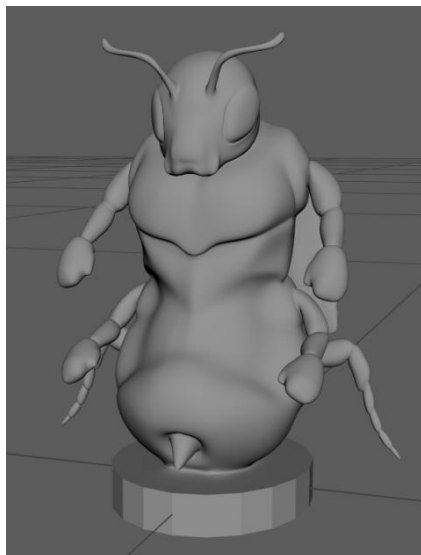
Beelancer - Ben



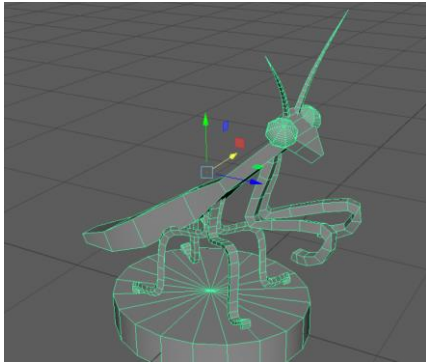
Ant Soldier - Tyler



Beetle Soldier - Xander



Bee Soldier - Andrew



Mantid Soldier - Jon

Game Flow

1. Players set up Hexes and pieces.
2. Players choose their Bug Corporation.
3. Gameplay begins, each turn follows five phases:
 - a. Collect resources from built factories and trade in resources if possible.
 - b. Move Soldiers one space and partake in combat with other Corporation's Soldiers. Move all Beelancers one space each.
 - c. Build factories, produce Bug Juice, and commence delivery of Bug Juice.
 - d. Destroy any unwanted factories with soldiers present.
4. The gameplay loop continues until one player completes three bug juice deliveries.

Development

Playtest Results

Playtest 1 (inter-group):

This was our first playtest as a group. The main problem was the rules were unclear, and we were not sure about certain mechanics. We also realized a scenario where a player could be caught without factories, which was corrected with the destroy phase. The main change from this was a firmer rulebook that went into more detail.

Playtest 2 (inter-group):

Our second group playtest went much smoother. We realized an issue with the Bees' ability, and changed it so the Bee could not get ahead of other players so quickly. The game went smoothly otherwise, and no other major changes were made.

Playtest 3 (inter-group, virtual):

This playtest was a little funky, due to the virtual nature. However, the game went much clearer. This was the first time we noticed we were able to understand the strategy and formulate multi-turn plans, but more importantly, that we had fun. We also thought about implementing a resource grab, to encourage combat more.

Playtest 4 (inter-group):

This playtest revealed the flaw of Mantis more than any other. Regardless of luck, they will be severely disadvantaged playing a game with 3 resources when only 2 can be gained at a time. We floated several buff ideas, but the one that makes the most sense is giving the Mantids a third factory so their buff does not come with a drawback.

Playtests 5 & 6:

This was the first time other groups playtested our game. Both groups played almost the same way, not really progressing past set-up. The largest issue was the board. Perhaps pieces could be glued together to reduce set-up time and potential board errors. We held off on giving Mantis a third factory to see how lack of experience would change play. It was unclear.

Playtest 7:

This group did not seem to have fun, the first time since that no player enjoyed the game. However, part of the issue was the failure to set up the map correctly, completely throwing off the delicate resource balance. This issue must be addressed, as it is too easy to mess up and throws off the entire game. This group also did not enjoy combat, and caused us to run the numbers on win probability and dice combinations. As it stands, the attacker only has about a 41.5% chance of winning. This is too low to make combat viable when your troop is returned to base, even with a resource grab in play. We will play around with dice combinations. Both sides

rolling a D20 gives the attacker about a 47.5% chance of winning. The attacker rolling a D12 and defender rolling a D10 gives the attacker about a 54.2% chance of winning. Both of these options need exploring.

Playtest 8 (inter-group):

We tested combat changes in this test. We set it so that having more surrounding soldiers changes the dice you roll. More soldiers means a die with more sides. These changes worked really well. However, they were a little cumbersome. It may have been better to use a system where players just roll multiple dice and take the highest roll. The odds are almost the same. Within .5% varied dice approach. We will test the multi-dice method next time.

Playtest 9 (inter-group):

We tested the multi-dice method, and it was better than the varied dice approach. It was much easier, and more straightforward. It also, despite the odds being the same, felt like the defender had more of a chance. There was no scenario where the defender could roll a six, but the attacker rolls an eight. We still aren't sure if Mantis needs more factories, but Mantis did win this game with only two factories. It did, however, require near-perfect play, which an outsider probably cannot do.

Playtest 10:

The group we observed played very well. The combat changes seemed to make the players have more fun. The Mantids and Beetles probably over engaged in combat, while the Bees and Ants under engaged. It showed, however, that combat is super important for the game to have random elements. Otherwise it is a solved game where one side wins every time.

Playtest Forms (Linked)

- [Observer 1](#)
- [Observer 2](#)
- [Observer 3](#)
- [Observer 4](#)
- [Observer 5](#)
- [Observer 6](#)
- [Observer 7](#)
- [Observer 8](#)
- [Observer 9](#)
- [Observer 10](#)
- [Out-of-Group Responses](#)

Future Work

As a team, we are happy with the work we did on the game. However, if we were to continue working on the project, there are changes we would like to make. We would like to change the game pieces from standees to models. We also would like to add more art to the box, as right now it is very basic. We would also like to make our rules a little more artsy, putting it in the form of a booklet. Adding in cheat sheets for individual players would also be a goal if we continued to work on the game.

Viability

Our game fits into the same market that enjoys Catan, Risk, and Monopoly. Bug Juice Inc. incorporates the same strategic elements as those games. Thankfully, those games enjoy a lot of success. According to [NPR in a 2020 article](#), Catan sales skyrocketed during the COVID pandemic, reaching 32 million units sold. Our game hopefully would capture the same market, with the bug aesthetic hopefully capturing a different subsection of the strategy game market than the more realistic style of Catan.

Development Costs

Our game was expensive for us to make. More expensive than is feasible for mass production. The game cost us \$126.33 to make. This breaks down specifically to \$43.26 in 3D printing, \$26.79 in wood, \$24.30 in paint, stain, and brushes, \$7.55 in glue, \$15.10 for a miter box/saw, and \$9.33 in other expenses. Some of these expenses are things that could be used for multiple production cycles. The paint, stain, brushes, glue, and miter box, among other things, could be used to make more copies of the game. However, the wood and 3D printing costs would be constants for every copy of the game.

These costs would likely go down if the game was mass produced. The wood box could be switched out for a more cost effective cardboard box. This would eliminate the need for stain as well. The painting could be eliminated by using different filament colors in line with what color the pieces need to be. This was not possible with the resources we had available. The Hex tiles could be swapped out for a printed board as well, although this would be sacrificing the affordances that the divots give for cost.

This game was also very labor intensive. Painting and gluing all the pieces, including the box, took over 24 hours. That cannot scale to mass production. This time could be reduced by having a printed board, printing in appropriate colors, and using a printed cardboard box. If you were to develop the game as is, it would take 24 people to churn out one game an hour, not accounting for time for pieces to dry or the substantial time for pieces to print. The time for printing all of the pieces is at least 72 hours, assuming nothing goes wrong.

Our game needs to be cut in cost to be viable. Printing in appropriate colors would be the easiest change, and the one that saves the most time. Without any changes, however, the game takes well over half a week to complete one copy, and costs over \$125.

Appendix

Ruleset - Starts on next page

BUG JUICE INC. - RULES

A competitive resource management game about bugs, industry, and capitalism.

The source of supreme insect nourishment is centered around a fast growing industry of a product called Bug Juice. Bug Juice is a cocktail of vital nutrients for all sorts of bugs that is being bought and sold in Sandbox City by the ounce! Looking to have a leg, pincer, horn, or antenna in this race, the 4 major insect companies of the yard use whichever tools they have at their disposal to worm their way up to the leading brand of bug mixture marketing. Will you ship the most Bug Juice and corner the market?



4 Players | Ages 12+ | 1-2 Hours

Setting Up the Game



- Lay out the Hexes according to the above graphic. (Tip: All of the elliptical slots should be in the same direction)
- Each player is assigned the Bug Corporation closest to where they are sitting. (See Bug Corporation Abilities)
- Each player starts with:
 - o 4 Soldiers (5 if Mantid Corporation)
 - o 3 Factories (2 if Mantid Corporation)
 - o 4 Beelancers
- Soldiers start at your Nest located at one of the corners on the map.
- Set aside your Factories and Beelancers for later use.
- Create a pile of Resource Tokens for players to take when needed.
- The Mantid Corporation goes first.

Game Pieces

- 95 Resource Tokens: 25 Dung, 25 Fiber, 25 Honey, 20 Juice
- 1 Sandbox City Hex
- 5 Dice
- 46 Terrain Hexes: 28 Land, 18 Ocean
- 12 Resource Hexes: 4 Old Hives, 4 Manure Piles, 4 Green Fields
- 17 Soldiers: 5 Mantid Corporation, 4 Beetle Brothers, 4 Bureau of Bees, 4 Leafcutter Collective
- 16 Beelancers: 4 Mantid Corporation, 4 Beetle Brothers, 4 Bureau of Bees, 4 Leafcutter Collective
- 11 Factories: 2 Mantid Corporation, 3 Beetle Brothers, 3 Bureau of Bees, 3 Leafcutter Collective
- 4 Nests: The Twiggy Shrubbery, The Rotted Log, The Royal Hive, The Ancient Hill

Bug Corporation Abilities

- **Mantid Corporation (Nest: The Twiggy Shrubbery):**
 - The Mantid Corporation has 1 extra Soldier and goes first at the beginning of the game
- **Beetle Brothers (Nest: The Rotted Log):**
 - The Beetle Brothers can produce Bug Juice with 1 Dung and 2 Fiber **OR** 2 Dung and 1 Fiber.
- **Bureau of Bees (Nest: The Royal Hive):**
 - The Bureau of Bees gains 2 Honey at each Factory on an Old Hive Hex.
- **Leafcutter Collective (Nest: The Ancient Hill):**
 - The Leafcutter Collective can send out Beelancers with 1 Honey **OR** 2 Fiber.

Objective

- The game is won by a player when their corporation completes 3 deliveries by taking them to the Sandbox City.

Playing the game:

Each player's turn follows through the 4 phases, play goes clockwise around the board. Actions within a phase may be completed in any order:

1. Gain/Trade Phase

- Gain resources from Factories.
- Players may trade in 5 resources of 1 type for 1 resource of another type.

2. Move/Combat Phase

- Soldiers may be moved 1 Hex. (2 if in the nest).
- Beelancers must be moved 1 Hex.
- Only 1 Soldier **OR** Beelancer can be on a Hex at a time.
- Soldiers may engage in combat (see Combat) with Soldiers or Beelancers on adjacent Hexes.
- Soldiers **may** enter Ocean Hexes and **may not** occupy Sandbox City at any time.
- Soldiers may leave Factories unoccupied. These Factories continue to produce resources. However, if an enemy Soldier enters a Hex with an unoccupied Factory, the Factory is destroyed. The destroyer gains a resource based on the Hex the Factory is on. This action counts as combat.

3. Action Phase

- **ONCE PER TURN**, a Factory can be built at no cost by a Soldier who has not participated in combat.
- **ONCE PER FACTORY PER TURN**, Bug Juice may be produced **OR** delivery may be commenced if a Soldier is present at your Factory.
- Producing Bug Juice:
 - Bug Juice costs 1 Dung and 2 Fiber to produce.
 - Upon producing Bug Juice, it is placed at the Factory it was created at.
- Commencing Delivery:
 - Delivery costs 1 Honey. Place it on the Hex.
 - Upon commencing delivery, clear the Hex for Beelancer take off (remove the Factory and return the Soldier to the Nest).
 - Place a Beelancer and move the Bug Juice and Honey with it.

4. Destroy Phase

- 1 Factory that does not have any Bug Juice present may be destroyed per turn if a Soldier is present on the Hex.
- If a Factory is destroyed, set it aside. The Soldier present is returned to the nest

Once the Destroy Phase is complete, play continues clockwise to the next player.

Combat:

1. Initiating:

- a. Combat can be initiated by any Soldier on their turn that has not moved or participated in combat and is adjacent to an enemy Soldier or Beelancer.
Only the soldier that initiates the attack participates in combat.

2. How Many Dice?

- a. The defending player gets to roll one die.
- b. The attacking player gets one die plus one for every ally Soldier surrounding the enemy Soldier's Hex. The ally soldiers are not considered to have participated in combat.

3. Roll:

- a. The attacking player rolls all of their dice. The die with the highest value is used to calculate the winner. (Ex: if an attacker rolled a 3, a 5, and a 1, the 5 would be used to determine the winner)
- b. The defending player rolls their die.

4. Winner:

- a. The player with the highest roll wins.
- b. If there is a tie, the defender wins.

5. Rewards:

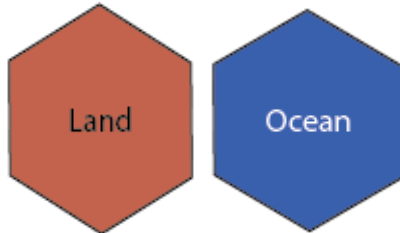
- a. If the attacker wins:
 - i. The defending Soldier is returned to its Nest.
 - 1. Defending Beelancers are set aside and any Bug Juice they are carrying is destroyed. The attacking player gains the resource they were carrying.
 - ii. The attacking Soldier moves into the space where the defending Soldier was. **This soldier cannot be moved or build factories until its next turn.**
 - iii. If a factory was present and on a Resource Hex, gain a resource according to the Hex.
- b. If the defender wins:

The attacking Soldier is returned to its Nest. **This soldier cannot be moved until its next turn.**

Piece Guide

Hexes:

Terrain Hexes:



These Hexes do not give resources but may be moved to, **Land** is able to have a Factory placed but does not give resources. **Ocean** cannot have a Factory but may be moved to by any piece.

Resource Hexes:



Resource Hexes give 1 resource per gain phase, **Green Field** gives Fiber, **Manure Pile** gives Dung, **Old Hive** gives Honey.

Nests:



Nests are where players start from and return Soldiers to. **The Ancient Hill**: Ants, **The Royal Hive**: Bees, **The Rotted Log**: Beetles, **The Twiggy Shrubbery**: Mantids.

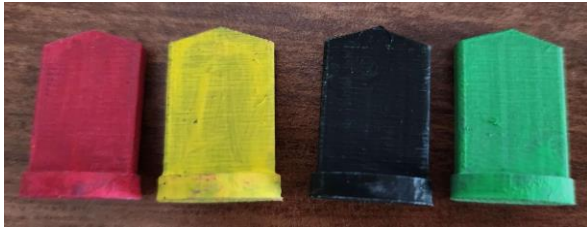
Sandbox City:



A special Hex not occupiable by Soldiers. Beelancers that make it here successfully complete a Bug Juice shipment.

Player Pieces:

Soldiers:



(Ants, Bees, Beetles, Mantis)

Players move Soldiers 1 Hex at a time (2 Hexes if in Nest). If 2 Soldiers are adjacent they may initiate combat. If a Soldier does not participate in combat they are allowed to place a Factory. 1 Factory may be built per turn.

Beelancers:



(Ants, Bees, Beetles, Mantis)

Beelancers are similar to Soldiers but they may not initiate combat nor place factories. Beelancers **must** be moved 1 Hex every turn. They are units for carrying Bug Juice to Sandbox city. Players pay them with Honey to commence delivery..

Factories:



(Ants, Bees, Beetles, Mantis)

Factories on Resource Hexes gain resources at the start of rounds and allow players to produce Bug Juice. Factories are used to create Bug Juice and commence delivery. Factories can be destroyed during combat or if left unoccupied.

Tokens:

Bug Juice:



Bug Juice is represented by this token.

Honey:



Honey is represented by this token.

Dung:



Dung is represented by this token.

Fiber:

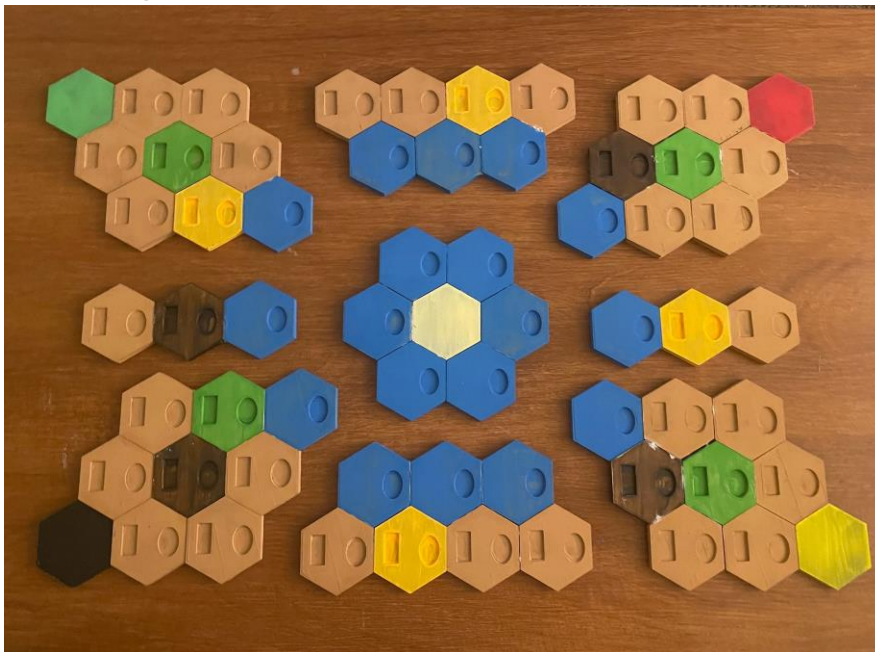


Fiber is represented by this token.

Views of Prototype -



View of game in most recent playtest



Glued pieces segmented out

Views of all other game pieces can be seen in the Piece Guide section of the rulebook.

Attack Odds/Dice Balancing Test Code -

1 Soldier Bordering, 1 Roll - 41.61%
2 Soldiers Bordering, 2 Rolls - 57.80%
3 Soldiers Bordering, 3 Rolls - 65.93%
4+ Soldiers Bordering, 4 Rolls - 70.78%

```
using System;  
using System.Collections.Generic;
```

```
class Program
```

```
{  
    //returns highest roll of an x sided die on y attempts  
    public static int DiceRoll(int sides, int rollNum)  
    {  
        Random rng = new Random();  
        int highRoll = 0;  
        for (int i = 0; i < rollNum; i++)  
        {  
            int roll = rng.Next(1, sides + 1);  
            if (highRoll < roll)  
            {  
                highRoll = roll;  
            }  
        }  
        return highRoll;  
    }  
  
    static void Main(string[] args)  
    {  
        double attackWin = 0, defendWin = 0;  
        //currently testing attacker with 4 dice, defender with 1  
        for (int i = 0; i < 1000000; i++)  
        {  
            int attack = DiceRoll(6, 4);  
            int defend = DiceRoll(6, 1);
```

```
        if (attack > defend)
        {
            attackWin++;
        }
        else if (defend >= attack)
        {
            defendWin++;
        }
    }
    Console.WriteLine($"Attack Wins: {attackWin}, Defend Wins:
{defendWin}, Attack Wins {attackWin / 1000000 * 100}%");
}
}
```