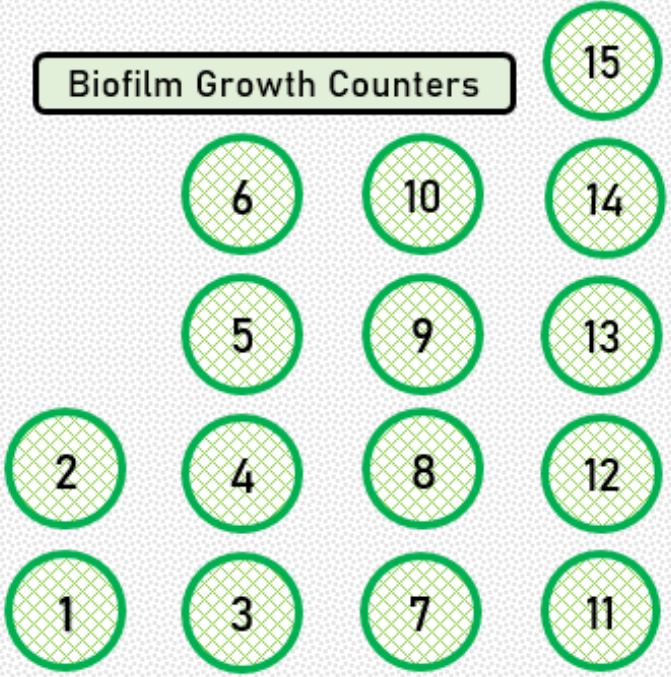
Biofilm Growth Counters



Aim of the Game: Take it in turns to reach 15 biofilm growth counters for your microbe before your opponent (2-4 players). A game has three "Battles" – with best of 3 Battles determining the winner.

Before the Game: Design a Battle Card Deck supporting the growth of a choice of 3 microbe cards that you have selected. There can only be a maximum of 3 of each kind of card and between 25 - 30 cards. See page 8 for help! Print or draw out your game board (page 7).

Before each Battle: From your roster of 3 microbe cards, select and place your first microbe into your microbe zone at same time as your opponent. Every battle must start with a different microbe card.

A Battle starts with 3 cards in the hand from a shuffled Battle Card Deck. Try not to show your opponent your cards.

A Turn starts by drawing a new card, then grow your microbe's biofilm or disrupt your opponent's microbe's growth using any number of battle cards.

At 10 biofilm growth counters your microbe cannot lose more than 2 counters as a result of a growth penalty battle card (↓) (the biofilm has matured and become more resistant).

At 15 biofilm growth counters, your microbe wins the round and is ready to disperse. These can be monitored on your game board.

A player also loses the battle if they have no more playable cards after their battle card deck is empty.

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Microbe Zone

Load your microbe into this space for it to grow. Microbes stay in this zone unless moved by other means.

Battle Card Zone

This Zone needs to be free to use Growth Promoting, Growth Penalty or General Active Cards.

Waste Zone

Gene Modification Card Zone

Place up to 1 "Gene Modification" Battle Card at a time here to affect your microbe.

They stay active in this zone until your microbe leaves its "Microbe Zone", They can only be removed by the effect of another battle card, or microbe.

Environment Battle Card Zone

Place "Environment" Battle Cards here. It can only be replaced by a new environment battle card, or removed by another effect.

Battle Card Deck

Place a shuffled deck of Battle Cards face down. There can only be a maximum of 3 of each kind of card and between 25-30 cards.

MicroBattle Project was funded by the National Biofilms Innovation Centre (NBIC) Public Engagement Grant 2020-2021.

MicroBattle – Aquatic Microbe Pack

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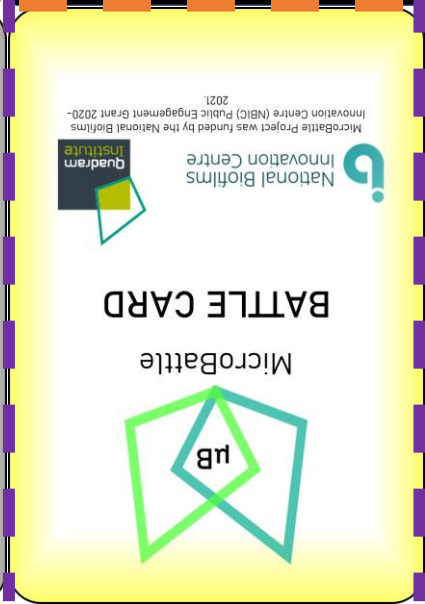
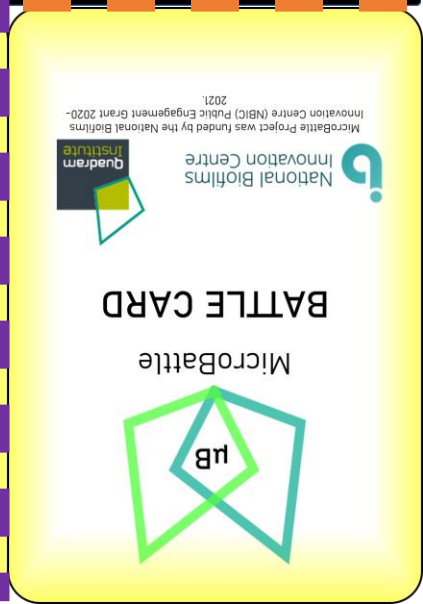
(1) Please trim white excess paper. (2) Fold along Orange Line and glue card backs together. (3) Cut along Purple Lines to separate cards after glue has set.

DRAG and DROP microbe and battle card images from the MicroBattle card folder into the respective slots. Distortion of card size may occur, but after cutting and trimming they will be playable.





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Dimethylsulfoniopropionate (DMSP)

Effect: Your microbe with "Aquatic" in its environment bonus gains 2 biofilm growth counters. Then shuffle this card back into your deck.

Sulphur is an important element for life. In aquatic environments, sulphur containing DMSP can be broken down into DMS, which gives the ocean its characteristic smell.

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Marine Snow

Effect: Your microbe with "Aquatic" in the environment bonus gains 3 biofilm growth counters. Then send this card to the waste zone.

Marine Snow refers to the shower of organic material descending from the upper layer of the ocean to the bottom. A feast for microbes.

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Amino Acids

Effect: Your microbe gains 3 biofilm growth counters, and all opposing microbes gain 1 biofilm growth counter. Then send this card to the waste zone.

Amino acids are the building blocks of all proteins. Most bacteria can produce most of the standard 20 by themselves but harvesting them from the environment can always help.

Adhesion Protein

Effect: If your microbe has 3 or less biofilm growth counters, your microbe gains 3 biofilm growth counters. Then send this card to the waste zone.

Microbes can produce glycosylated proteins (coated in sugars) attached to the cell wall to adhere to surfaces and each other. Adhesion is an essential step in biofilm formation.

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Fresh water, oceans, the water in your boiler can all be occupied by free living microbes. Surfaces in these aquatic environments are also quickly occupied by biofilms.

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Niche Occupation

Effect: Add 1 "Environment Battle Card" from your deck to your hand and shuffle that deck. Then send this card to the waste zone.

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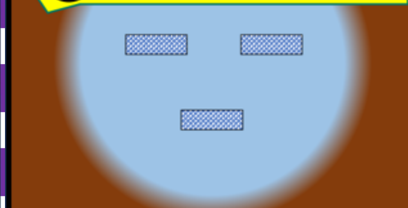
Protozoa



Effect: If an environment battle card with "Aquatic" or "Soil" in its name is in your zone, remove up to 3 biofilm growth counters from all opposing microbes. All opponent's send the top card of their battle card deck to the waste zone. Then send this card to the waste zone.

Protozoa are single-cell organisms that can be free-living and/or parasitic. A common example would be an Amoeba. Many are known to feed on other microbes.

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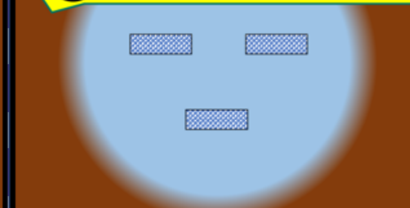

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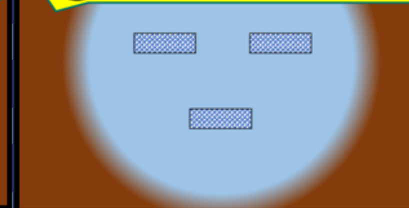

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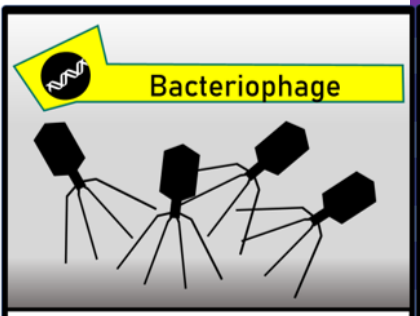
Bacteriophage



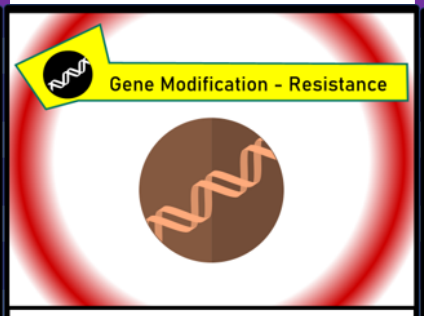
Effect: Choose and apply 1 of these 3 effects:

- Remove 3 biofilm growth counters from all microbes.
- Add 1 "Gene Modification" active card from your battle card deck to your hand. Then shuffle that deck.
- Move 1 of your opponent's "Gene Modification" battle cards to the waste zone. "

Then send this card to the waste zone.

Bacteriophages are viruses that infect bacteria and archaea. They use the host's genetic machinery, and sometimes a bit of the previous host's genomic DNA may get distributed.

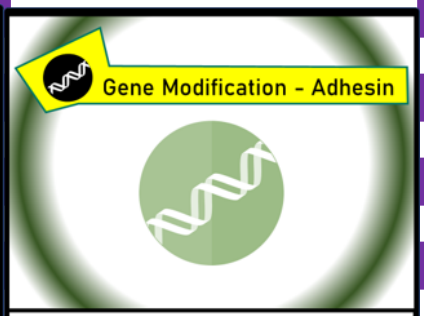
Gene Modification - Resistance



Effect: This card remains in the appropriate battle card zone and is associated with your microbe. When your microbe leaves its zone, this card is moved to the waste zone.
Once during either player's turn in response to a growth penalty (↓) battle card, your microbe loses a maximum of 1 biofilm growth counter.

Genes that provide resistances to anti-microbial compounds or improve survivability can be transferred from microbe to microbe. And so antibiotic resistances are a current health care crisis.

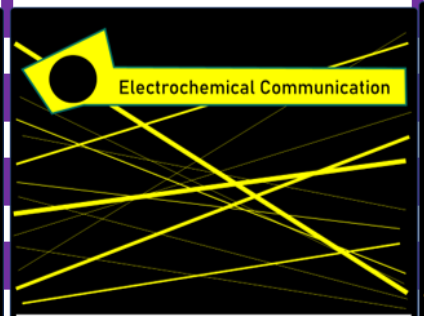
Gene Modification - Adhesin



Effect: This card remains in the appropriate battle card zone and is associated with your microbe. When your microbe leaves its zone, this card is moved to the waste zone.
Your microbe's biofilm growth counters can no longer go below 5.

Adhesins can allow microbes to attach to surfaces or aggregate with each other which is essential for biofilm formation. These can be modified in their composition to enhance binding.

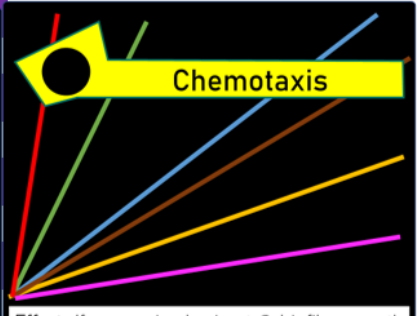
Electrochemical Communication



Effect: Shuffle 1 growth promoting (↑) battle card into your battle card deck. Draw 2 new cards. Then send this card to the waste zone.

Microbes in a biofilm can signal electrochemically similarly to neurons. This can be to respond to external stressors and coordinate nutrient distribution.

Chemotaxis



Effect: If your microbe is at 3 biofilm growth counters or less, or 13 biofilm growth counters or more, apply the following effect: Draw 1 new card from your Battle Card Deck. Then send this card to the waste zone.

Chemotaxis refers to mobility and navigation in the direction of a molecule of interest (nutrients, signals from other microbes or hosts). Whilst the mature biofilm is static there is movement at the beginning and end of the cycle.