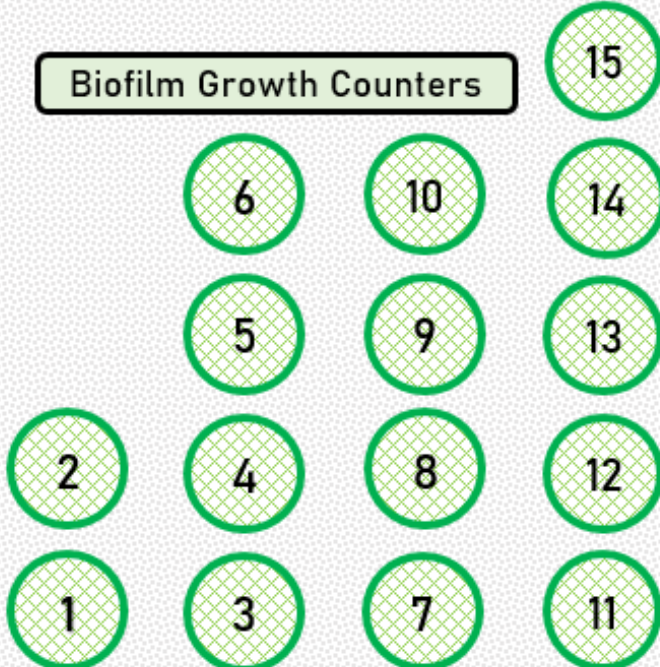


Biofilm Growth Counters



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.



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.

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.

The image displays a collection of MicroBattle cards, organized into two rows and five columns. The top row contains three environment cards, each with a unique illustration and specific abilities. The bottom row contains two battle cards and three microbe cards, all featuring a green pentagon logo with the letters 'uB' inside. The cards are color-coded: orange for environment, yellow for battle, and grey for microbe.

Environment Cards (Top Row):

- Pyrococcus furiosus:** Illustration of a fire demon. Ability: THERMAL STABILITY! Two following two effects apply: This card is not affected by "Gene Modification" Battle Cards. During every start of your turn, this microbe gains 2 biofilm growth counters when an Environment Battle Card with "Extremophile" in its name is in your zone.
- Halobacterium salinarum:** Illustration of a woman with a sun halo. Ability: ANCIENT DNA. Two following two effects apply: This microbe only gains a maximum of 1 biofilm growth counters from "Growth Promoting" (†) Battle Cards. Once during your turn, this microbe gains 2 biofilm growth counters.
- Sulfolobus acidocaldarius:** Illustration of a Native American. Ability: SOPHISTICATED DNA REPAIR. Every time a battle card with "Radiation" or "Extremophile" in its name is played, this microbe gains 1 biofilm growth counter.

Battle Cards (Bottom Row, Columns 4 and 5):

- Extremophile:** Effect: While this card is active, all other "Environment Battle Cards" have their effects negated/ignored. This card remains on the environment battle card zone, unless replaced by another environment battle card or moved to the waste zone by another effect. Boiling temperatures. Concentrated salts. High pressure. Corrosive acidity. For some microbes only the most extreme conditions are optimal.

Microbe Cards (Bottom Row, Columns 1, 2, and 3):

- MICROBE CARD:** Features a green pentagon logo with the letters 'uB' inside. The card is grey.

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<div><div><div>↑</div><div>Dimethylsulfoniopropionate (DMSP)</div></div><div><div>+</div><div>+</div></div></div> <div><p>Effect: Your microbe with "Aquatic" in its environment bonus gains 2 biofilm growth counters. Then shuffle this card back into your deck.</p><p>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.</p></div>	<div><div><div>↑</div><div>Dimethylsulfoniopropionate (DMSP)</div></div><div><div>+</div><div>+</div></div></div> <div><p>Effect: Your microbe with "Aquatic" in its environment bonus gains 2 biofilm growth counters. Then shuffle this card back into your deck.</p><p>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.</p></div>	<div><div><div>+</div></div><div>Aquatic</div></div> <div><p>Effect: When this card comes into play, all microbes with "Aquatic" in the environment bonus gain 2 biofilm growth counters. This card remains on the environment battle card zone, unless replaced by another environment battle card or moved to the waste zone by another effect.</p><p>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.</p></div>	<div><div><div>+</div></div><div>Aquatic</div></div> <div><p>Effect: When this card comes into play, all microbes with "Aquatic" in the environment bonus gain 2 biofilm growth counters. This card remains on the environment battle card zone, unless replaced by another environment battle card or moved to the waste zone by another effect.</p><p>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.</p></div>	<div><div><div>+</div></div><div>Extremophile</div></div> <div><p>Effect: While this card is active, all other "Environment Battle Cards" have their effects negated/ignored. This card remains on the environment battle card zone, unless replaced by another environment battle card or moved to the waste zone by another effect.</p><p>Boiling temperatures. Concentrated salts. High pressure. Corrosive acidity. For some microbes only the most extreme conditions are optimal.</p></div>
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<div><div><div>↑</div><div>Marine Snow</div></div><div></div><div><p>Effect: Your microbe with "Aquatic" in the environment bonus gains 3 biofilm growth counters. Then send this card to the waste zone.</p><p><i>Marine Snow refers to the shower of organic material descending from the upper layer of the ocean to the bottom. A feast for microbes.</i></p></div></div>	<div><div><div>↑</div><div>Marine Snow</div></div><div></div><div><p>Effect: Your microbe with "Aquatic" in the environment bonus gains 3 biofilm growth counters. Then send this card to the waste zone.</p><p><i>Marine Snow refers to the shower of organic material descending from the upper layer of the ocean to the bottom. A feast for microbes.</i></p></div></div>	<div><div><div>↑</div><div>Extremotroph</div></div><div></div><div><p>Effect: If your microbe has "Extremophile" in its environment bonus, it gains 2 biofilm growth counters, and you draw 1 card from your battle card deck. Then move this card to the waste zone.</p><p><i>Literally "Extreme Food". Plastic, metals, radioactive waste... That which feeds on matter not typically considered food.</i></p></div></div>	<div><div><div>↑</div><div>Extremotroph</div></div><div></div><div><p>Effect: If your microbe has "Extremophile" in its environment bonus, it gains 2 biofilm growth counters, and you draw 1 card from your battle card deck. Then move this card to the waste zone.</p><p><i>Literally "Extreme Food". Plastic, metals, radioactive waste... That which feeds on matter not typically considered food.</i></p></div></div>	<div><div><div>↑</div><div>Extremotroph</div></div><div></div><div><p>Effect: If your microbe has "Extremophile" in its environment bonus, it gains 2 biofilm growth counters, and you draw 1 card from your battle card deck. Then move this card to the waste zone.</p><p><i>Literally "Extreme Food". Plastic, metals, radioactive waste... That which feeds on matter not typically considered food.</i></p></div></div>
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MicroBattle – Archaea Pack

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<div><div>↑</div><div>Marine Snow</div><div></div><div><p>Effect: Your microbe with "Aquatic" in the environment bonus gains 3 biofilm growth counters. Then send this card to the waste zone.</p><p><i>Marine Snow refers to the shower of organic material descending from the upper layer of the ocean to the bottom. A feast for microbes.</i></p></div></div>	<div><div>↑</div><div>Algal Bloom</div><div></div><div><p>Effect: Send one "Aquatic" environment battle card from your hand or environment battle zone to the waste zone. Your microbe with "Aquatic" in the environment bonus gains 3 biofilm growth counters. All players send two cards from the top of their battle card decks to the waste zone. Then send this card to the waste zone.</p><p><i>Climate change is causing ideal growth environments for many aquatic microbes. However, after too much growth and disruption of the ecosystem consequences follow...</i></p></div></div>	<div><div>↑</div><div>Adhesion Protein</div><div></div><div><p>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.</p><p><i>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.</i></p></div></div>	<div><div>↑</div><div>Amino Acids</div><div></div><div><p>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.</p><p><i>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.</i></p></div></div>	<div><div>↑</div><div>Carbohydrates</div><div></div><div><p>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.</p><p><i>Carbohydrates are everywhere. Sugars, starches, attached to proteins... They can be an essential source of carbon for microbes.</i></p></div></div>
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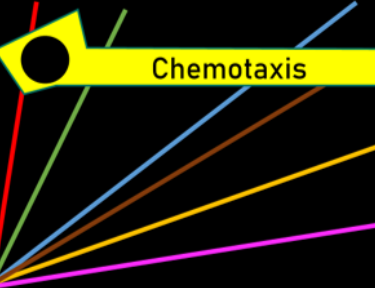

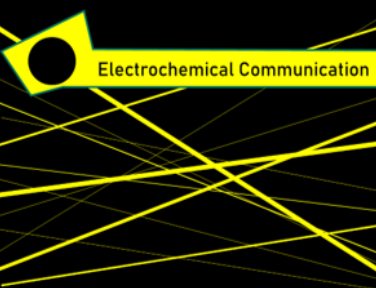

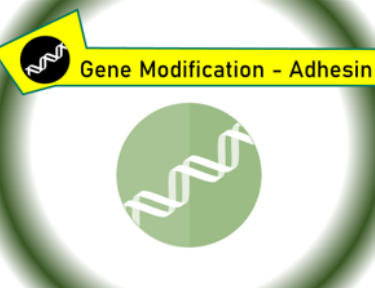










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<div><div><div>Chemotaxis</div><div></div><div><p>Effect: If your microbe is at 3 biofilm growth counters or less, or 13 biofilm growth counters or more, apply the following effect: Draw 1 new card from your Battle Card Deck. Then send this card to the waste zone.</p><p><i>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.</i></p></div></div></div>	<div><div><div>Community Biofilm</div><div></div><div><p>Effect: Discard 1 card from your hand to the waste zone to activate this card. Swap your current microbe with another one of your microbes retaining all growth counters and draw 1 new card from your Battle Card Deck. Then send this card to the waste zone.</p><p><i>Mixed-species biofilms are the dominant form in nature leading to fascinating nutrient competition and communication dynamics.</i></p></div></div></div>	<div><div><div>Electrochemical Communication</div><div></div><div><p>Effect: Shuffle 1 growth promoting (↑) battle card into your battle card deck. Draw 2 new cards. Then send this card to the waste zone.</p><p><i>Microbes in a biofilm can signal electrochemically similarly to neurons. This can be to respond to external stressors and coordinate nutrient distribution.</i></p></div></div></div>	<div><div><div>Niche Occupation</div><div></div><div><p>Effect: Add 1 "Environment Battle Card" from your deck to your hand and shuffle that deck. Then send this card to the waste zone.</p><p><i>Organisms have often evolved to be highly adapted to a particular ecosystem and life cycle.</i></p></div></div></div>	<div><div><div>Gene Modification – Adhesin</div><div></div><div><p>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 growth counters can no longer go below 5.</p><p><i>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.</i></p></div></div></div>
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