



# The Last Microbe Standing©: The Survival Game for our Microbial World

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## OVERVIEW

**Microbes.** Tiny organisms, almost impossible to see and seemingly insignificant. But they are everywhere and influence almost everything. You can't really understand life on earth without knowing something about microbes.

They affect the environment and all living things, particularly humans. Millions and millions live inside us. They decide how we sleep, feel, and function. In a way, we are a mass of swirling microbes. Many more microbial cells than human cells lie within our bodies.

They take many different forms. Some are good for us. Others not so much. They can help us digest food, and they can give us disease.

So, science is on a grand quest to maximize the good stuff, to limit the bad, and to better understand the role microbes play in health research, agriculture, ecology, and many other fields. But it's not so easy. It's complicated and dynamic.

**Mobile DNA.** Microbes not only impact their hosts, things like you and me, but also impact each other. They have their own microbiomes, meaning that they themselves carry around ultra-tiny microbes, often in the form of free-floating bits of genetic material known as **mobile DNA** (Deoxyribonucleic acid). Mobile DNA can also be good or bad for their hosts which, in turn, can mean either magnified good or bad for you and me.

Unlike DNA that is inherited or passed down from one generation to the next, mobile DNA can jump from one microbe to another and can come from the surrounding environment. Through a technique known as next generation sequencing, scientists have learned that mobile DNA exists in almost every form of life, particularly within microbes. But researchers are only beginning to grasp the role mobile DNA plays in things like antibiotic resistance, the spread of infectious disease, and the process of natural selection involved in evolution. Scientists from many fields are coming together to study mobile DNA for human health, the environment, and the world.

## The Game

Understanding how interactions among microbes and mobile DNA play out in the real world is tricky, dynamic, and challenging. Things that when combined with a compelling goal make for a great game.

The goal for all microbes is to survive and thrive, and, so far, they've done this really, really well. They have been around for much longer than humans, and again, are found everywhere -- thriving in some of the most extreme environments on earth including hot springs that can reach temperatures upwards of 80°C!

We need to understand the keys to microbial success (and demise) in order to confront many of the challenges facing human-beings and the world. Doing so may very well tell us something about our own best options for survival and growth.

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**The Last Microbe Standing©** is a board game developed to foster this understanding, to help us appreciate the science, and to present a fun way to learn about one of the most important features of life on earth.

**The object of the game is, as implied by its name, to survive: to be the player with a microbe that endures until the final round through the evolutionary process of selection.**

## Set Up

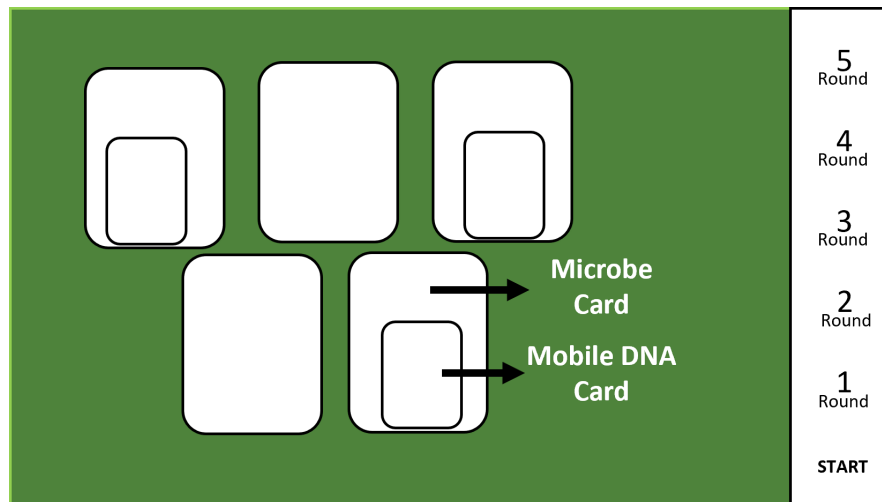
1. **The Playing Board:** The playing board is a smooth surface with no markings except for the list of “Rounds” of play on the side. This allows players to arrange their playing cards in whatever manner suits the configuration and quantity of cards in play.
2. **Set of Microbe Cards:** The microbe playing cards feature cartoon character microbes with nicknames for easy recall on the front and with their scientific or binomial Latin names on the back. The back also has a light description of each microbe's strengths and vulnerabilities labelled “Superpowers” and “Kryptonite.”
3. **Set of Mobile DNA Cards:** The smaller mobile DNA playing cards also feature cartoon images, but instead of nicknames, they are labelled by the class of submicroscopic form they represent such as a type of virus or a DNA molecule. The back of these cards presents their Superpowers (their behaviour or impact within host microbes) alone.
4. **Two-part Tabletop Spinning Wheel:** The game spinning wheel has two parts – an outer wheel that decides a next step at the microbe-card level, and an inner wheel that decides actions involving the mobile DNA-cards.

## Before Beginning the Game

Each Player:

- chooses any five (5) of the larger **microbe cards** (even multiples of the same card) from the deck, looking at and considering the Superpowers and Kryptonite for each. (As you become more and more expert in the game, these features will have greater meaning. But it's okay to make random choices to start);
- lays the five cards out on the blank area of the game board in any spatial arrangement they like;
- then picks three (3) of the smaller **mobile DNA cards** placing them on top of any of their microbe cards they like (you can even put two or three of the mobile DNA cards on one microbe card)

Figure 1 below shows an example board with cards placed on top.



**Figure 1.** Example board set up showing the five (5) microbe cards (larger of the two card types) and the three (3) mobile DNA cards (smaller of the two card types). The "Rounds" of each game are listed on the right of the board. Players can use a token or coin to track which round of the game they are currently on.

## Playing the Game

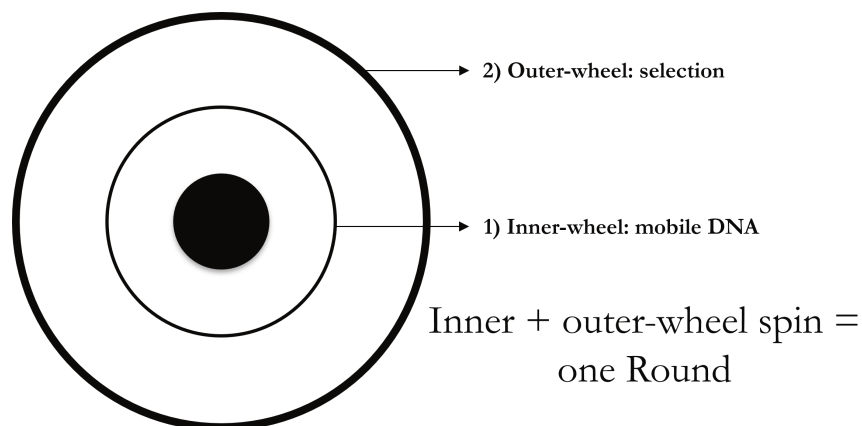
Microbes live in every kind of habitat: land, water, air, human bodies, and more. Their environment defines their ability to grow and survive, and the microbes and their mobile DNA in turn affect their environments. Although some microbes can survive almost anywhere, others are vulnerable to changes in their environment and can be eliminated through the resulting selection process. Each "Round" of play illustrates the complexity of this process with a change in the "Environment" that induces action on and reactions by the microbes.

### The Spinning Wheel and the Process of Selection

Each player spins the game wheel in turn.

One "Round" of play results in two different directives (Figure 2):

- one spin at the outer ring of the wheel for the microbe as a whole,
- and one spin on the inner ring relating to the mobile DNA.



**Figure 2.** Wheel with two rings: the inner ring with directives related to mobile DNA, while the outer ring has directives relating to the microbe (plus its mobile DNA if applicable). An inner spin plus outer spin equal one Round of the game.

All players are required to apply both of these directives with reference to their playing cards, beginning with the inner ring directive and then the outer one. The right to spin the wheel passes counter clockwise around the table continuing to a fifth spin or the final round of play.

At each round, you will see that some environments favour particular microbes and disfavour others. Other environments will favour specific microbe-mobile DNA combinations. Those that are favoured will survive to another round; those that are not will be impaired or “Selected” out and eliminated from further play. Through this simplified approach, young children can engage with the microbes and play a game to completion with no prior experience or scientific knowledge.

But **The Last Microbe Standing**© allows for formats that can challenge players with greater skill and greater understanding of the various microbes. These other approaches could involve blind card selection and point systems that reward knowledge of scientific naming as well as the cited Superpower strengths and Kryptonite vulnerabilities. You could even double the environments at play at one time. We invite you to use your imagination. The possibilities are nearly limitless, just like the microbial world.

## Game development background

**The Last Microbe Standing**© was developed in 2019 by Dr. Rebecca Doyle, now an Assistant Professor at McMaster University, Hamilton, Canada, while at the Carl R. Woese Institute for Genomic Biology (IGB), University of Illinois (Urbana-Champaign). Dr. Doyle was supported by IGB’s Infection Genomics for One Health Outreach Team, including Professors Katy Heath and Rachel Whitaker. The game was first debuted at the Institute’s largest science outreach initiative of the year: the World of Genomics exhibition at the National Academy of Sciences (NAS) in Washington, D.C. It was created to introduce children and their parents to the importance of microbial life in general and to share the excitement and fun of research in this field. The game guide (i.e., this document) was co-written by Dick Bourgeois-Doyle, Michèle Bourgeois-Doyle, and Dr. Doyle. In 2022, the copyright for **The Last Microbe Standing**© was registered under Dr. Doyle’s name (registration number: 1195080) via the Canadian Intellectual Property Office.

## Additional information:

This guide was compiled using the freely available  $\LaTeX$  template [at this link](#). The SyM<sup>3</sup> Lab logo on the first page of the guide was illustrated by Lu Loram-Martin.