The Survival Game after Columbus: Pigs, Weeds, and Other Players

At the beginning of 1492, the Old World and the New had been cut off from each other for approximately 10,000 years. Now this separation was about to end.

For weeks, three small Spanish ships had been venturing farther from Europe into the uncharted waters of the western Atlantic, through unfamiliar winds and currents. Columbus on board was even positive that there was land out there. Columbus, the leader of the expedition, had been deliberately under-reporting the distances traveled each day, in an effort to assuage his sailors’ anxiety. Even so their fear of the unknown was bringing them to the edge of mutiny.

Then, on the evening of October 11, land was sighted—the Bahamas (though those on shipboard thought they were seeing Asia).

The next day, a party of Europeans stepped ashore onto American soil . . . establishing a contact between Old World and New that has continued to this day.

There was no way that these people could possibly have guessed what massive trains of cause and effect they were setting in motion—trains of cause and effect that today are still shaping our lives.

What happens when living creatures from two worlds that have been evolving separately for 10,000 years are suddenly thrown together?

It was as if the wall separating* two rooms stuffed full of living creatures had been torn open. Creatures from both rooms began to pour through the opening, bumping into each other, attacking, fighting back, competing, eating, being eaten, struggling to find food and living space and safety in a scheme of things that was suddenly completely different.

Even while the Europeans and the Indians were examining each other with amazement and struggling to exchange thoughts without a common language . . . biological exchanges were proceeding fast.

Microorganisms from European lungs were being breathed out into the New World air . . . and being sucked into Indian lungs. Seeds stuck to Spanish boots were being scraped off and ground into American soil. Soon American foods would be entering European stomachs, and Indians would be sampling European foods the Spaniards offered. European body wastes, along with the bacteria and parasites they contained, would be deposited on New World soil. Spaniards would be packing up samples of American plants and animals, and kidnapping some Indians, to show off back in Spain . . .

And this was just the beginning of an endless stream of further arrivals from the Old World: human beings, dogs, pigs, horses, cattle, food plants, grape cuttings, fruit pits, olive trees . . . and more and more varieties of unwittingly carried seeds and spores and germs.

But before going on with this story, let’s leave this scene and set up an analogy that can help your students focus on some biological essentials of the upheavals that Columbus was setting in motion. (Please stop here and read “The Game of Survival,” on the Pull-Out Page. Then continue with this Teacher’s Background.)

Since our space is limited, we can discuss only a few examples in this ART TO ZOO. We have chosen ones that suggest parallels that your students can discuss . . . and that illustrate ecological principles that have vital implications for us today.

Livestock Colonizers

Human beings and their livestock (pigs and cattle will be our main focus here) had been living close to each other and depending on each other for thousands of years in the Old World. People there had their herds to pasture, provided water and winter fodder, set shepherds to guard flocks against predators, and provided barnyard shelter when necessary.

For these human populations, taking care of their livestock was a move that paid off: the livestock played a vital role in helping the human beings survive. People ate their animals’ meat, drank their milk, wrapped themselves in their hides, rode on their backs, and used their musclepower to haul their plows and carts and carriages . . .

Naturally, when Europeans came to the New World, they brought livestock with them.

What happened to those Old World animals when they were set down in the New World—where the game had developed with different players, into a different set-up?*

Most domesticated animals from the Old World did well in the New. They multiplied dramatically, spreading into more and more regions. Some ran off and flourished in the wild.

Pigs followed this pattern the soonest and fastest. They were ideal colonists—tough, omnivorous, and prolific. They gorged themselves on the abundant fruits and nuts of the Antilles, where they were first set down, and began producing three litters a year.

Soon more and more pigs were eating their way across more and more New World areas: gobbling nuts and fruits, gouging up roots, ripping out plants . . .

Cattle too raised havoc in their new surroundings, as they ate and trampled their way through populations of native plants unadapted to abuse on this scale. It wasn’t many years before herds had established themselves up and down the Americas.

When these and other Old World hoofed farm animals stepped onto New World soil after crossing the Atlantic, they were entering a world that had been proceeding along different lines from back home. These animals thrived in their new surroundings because, in the main, they found there ample food, few competitors, few predators, and few diseases to which they were susceptible.

The contrasting histories of the Old and New Worlds provide some clues to why this was so.

In the Old World, where hoofed grazers (both domesticated and wild) were numerous, whole networks of players had evolved together. The various species developed ways of surviving in each others’ presence . . . and even of using each others’ presence as their means of surviving. Germs and worms evolved that could use grazing mammals as hosts. Predators were drawn to places where livestock offered easy prey: wolves stole lambs from flocks; foxes stole chickens from barnyards. And plant species that evolved in ways that allowed them to survive and reproduce even after being trampled.
and gained a competitive edge.

The New World was a different story. American Indians were superb plant growers, but they had few domesticated animals: some dogs, guinea pigs; a few kinds of fowl; and, in the Andes, llamas and alpacas. Large wild herds of hoofed grazers were also common in the parts of the New World where the Spanish settled early on.*

*Further north, to what are now the United States and Canada, there were huge herds of buffalo.

This situation made for different developments. Here in the New World, parasites were adapted to New World animals, not to the Old World grazers. Here, most plant populations were not particularly well equipped for surviving heavy onslaughts from animals, because until the spread of European livestock, so do had offered no particular survival advantage. And here there were few predators able to prey on animals as large and tough as these European pigs and cattle.

This situation gave the Old World animals an opening in the game—and they were quick to take advantage of it. But winning moves by some players spell losses for others.

The proliferation of Old World livestock in the Americas was as far-sighted and, even impossible, for many of the native American plants and peoples. As Old World cattle, pigs, and horses spread across American landscapes, they pushed down the soil with their hooves, crushed plants underfoot, grave down plants. . . . Result: in place after place, native plant populations were snuffed out.

The spread of Old World livestock made survival harder for native people too. Plant foods were the majority of their diets. As the herds grew, local humans found themselves competing with the livestock (especially with pigs) for wild plant foods that belonged to them. Meanwhile, the Europeans were turning more and more land into pasture. Often this meant that the Indians could not even count on harvesting the produce they planted in the gardens they were able to hold on to—because livestock from nearby, usually unfenced, pasturage were apt to wander in, trampling and consuming the crops.

But the game—the environment—never stands still. As the years passed, the livestock lost some of that initial competitive edge. Most importantly, the newcomer animals began in many places to eat their way through their food supply. The animals’ initial population explosion usually lasted only a few decades in any area.

Take cattle in what is now Mexico, for example. They were introduced for breeding purposes in 1521. At first there were so few that killing any was forbidden. But within just a few years, the cattle were doing so well that cattle ranches were springing up all around. When the cattle spread into the rich grasslands in the northern part of the country, their rate of increase soared even higher. One writer noted in 1579 that a herd of 20,000 was considered small in these parts, and some ranchers had as many as 150,000. (Back in Spain, herds of over 1,000 were rare.) Yet by the late 1500s, large areas of central Mexico had been so overgrazed that cattle in some places were starving to death. The great herds began to shrink.

Plant Colonizers

For Old World people and their animals, moving to the New World created opportunities to prosper. But they were not the only newcomers for whom the move was advantageous: Old World plants too were soon spreading over the Americas.

Some of these plants were brought over on purpose. Like the livestock, they were, by Spanish colonists eager to have a local supply of the foods they were used to. The Americas offered variety enough in climates, soil, and weather to allow European crop could find a place there to flourish. It wasn’t long before Spaniards in the New World were eating bread made from Old World wheats, olives grown where once American-grown trees, washed down with wine pressed from American-grown grapes—even though none of these food plants had existed in the Americas before.

In addition to these and countless other Old World food plants that were brought over and cultivated, numerous wild Old World plants—weeds—came to the New World and flourished. When the European livestock population was originally introduced, native plant populations out of existence, it was very often Old World plants that moved in to replace them. In the West Indies, for example, those species that were proliferating by the early 1500s. In Peru, European colonizer spread so aggressively that they strangled native crops in many areas. And by the end of the century, the weed population of central Mexico was made up mostly of Eurasian plants.

Why was it that Old World plants—rather than indigenous New World ones—so often moved in when local plant populations were destroyed? They were introduced for breeding purposes in 1521. Back in Spain, herds of over 1,000 were rare.) Yet by the late 1500s, large areas of central Mexico had been so overgrazed that cattle in some places were starving to death. The great herds began to shrink.

Weeds grow exuberantly under what would seem to be the worst of conditions—in habitats that have been deeply disturbed: plowed up, burnt over, flooded out. Weeds can thrive in the scorching sunlight of stripped spaces. They grow fast. They propagate under conditions that kill off less aggressive species. Weeds often possess several ways of propagating: by means of shoots, for instance, bits of root, bulbs, runners that snake out over the ground, or seeds that can survive passage through an animal’s digestive system and sprout in new territory by spouting whenever they emerge.

Back in Europe, there were plenty of disturbed areas where these qualities were called for. For thousands of years there, herds of animals had been trampling and munching, and human beings had been plowing up fields, clearing forests, and building roads and towns. Where such conditions prevailed, it was the plants with weedy resilience that best survived. . . . and by competing with each other over the centuries, they became even better at flourishing in adversity.

New World conditions were quite different. Fewer people, as well as fewer grazing mammals, lived there. Estimates of the total human population of the Americas at the beginning of 1492 vary widely, but around 100 million people would be in the reasonable range. At the same time, the Old World population was probably approaching 600 million.

In other words (since the Americas together cover half the area of Europe, Asia, and Africa together) the New World had on average one-third the Old World’s population density—one-third the number of people per square mile, on average, to tear up their surroundings. Moreover, New World people had lifestyles that tended to be less destructive of their environments than the lifestyles of Old World people.

American Indians, for example, used digging sticks and hoes—far less invasive agricultural tools than the European plows, which could churn up whole fields.

With the arrival of the Europeans, this changed. Wherever they settled, these new humans newcomers created upheavals in their surroundings. They burned and cut down forests, plowed up land, set loose livestock, dug mines. . . .

In short, they created just the kinds of conditions that Old World weeds—particularly well-adapted to taking advantage of. Transported to the Americas, these plants moved quickly, making the most of a superb opening in the game.

Germ Colonizers

In the years after the two worlds came into contact, epidemic after epidemic of Old World diseases struck down staggering numbers of Indians. Over and over, down on into our own century, whenever formerly isolated New World populations have come into contact with Old World people, Old World diseases have taken heavy tolls.

These Old World diseases spread for many of the same reasons that Old World livestock and Old World weeds spread: thrust into the New World, they found themselves in surroundings that offered plenty of food and few enemies—surroundings suited to a different combination of players.

To understand why Old World diseases struck the way they did, it is necessary to think about the fact that germs (like livestock and weeds) are living creatures. Like all living creatures, they have to find the resources they need or they will die. They too play the game.

From people’s point of view, the germ that infect them with a serious disease are a threat. But from the germ’s point of view, the people are an opportunity—a place to live, an environment that can provide food and shelter.

For a population of germs and a population of hosts (people are the host species we are talking about here) to keep living in the same geographical area, they have to reach some kind of balance. Otherwise, one or both of the populations will die out.
Diseases seemed to single out New World victims. They also seemed to travel from Old World to New, but seldom in the opposite direction. They also seemed to travel from Old World to New, through the Middle East, and into Africa, Europeans produce antibodies to them. For this reason, the Europeans had no chance to develop immunities to foreign germs.

The Bering "decontamination chamber." What about the germs that the original Americans brought with them when they crossed over from Asia? Didn't they bring Asian (Old World) germs? Probably far fewer than if they had crossed into the Americas through a militant area. The cold in the Bering land bridge area probably killed off a lot of the germs that the immigrants carried. Their bodies had already produced antibodies, and only healthy people were likely to have survived the rigors of the trip. The first New World peoples probably entered the Americas relatively disease-free.

Smallpox. Smallpox was probably the first massive epidemic of an Old World disease to occur in the Americas. It arrived in 1518, when it landed on Hispaniola (the island that today comprises Haiti and the Dominican Republic) and wiped out all but a thousand of the Indians living there. Then it spread to the rest of the Americas. Wherever the smallpox germs went, most Indians died. In Mexico, smallpox struck just as the Aztec Indians were preparing to attack the small band of Spanish invaders. In Peru a few years later, it killed off—among countless other victims—both the Inca leader and his successor within just a few hours, leaving the indigenous government in disorder.

The Spaniards, meanwhile, remained untouched. To both Spaniards and Indians, it must have seemed that heaven had turned its back on the native Americans. Even places that Europeans never visited directly could export germs—for a disease could spread from person to person along trade routes.

Diseases from all over the Old World thrived in Europe, especially in large ports, where crowding and poor sanitation created ideal conditions for the spread of illness. Smallpox, typhus, measles, and other diseases kept permanent residence in such places. Virtually all city dwellers who survived to adulthood had become immune. Yet the germs causing the illnesses did not die out, because there were always enough children being born so the germs could find vulnerable hosts.

New World. Circumstances in the Americas right before Columbus were very different—and, unfortunately, perfectly suited to maximize the spread of imported diseases.

Isolation had prevented the development of immunity. Since the Americas had been cut off from the rest of the world for about 10,000 years, the Indians had had no chance to develop immunities to foreign germs.

Step 1: How Many Pigs?

Begin by having your students carry out the "How Many Pigs?" activity on the Pull-Out Page, as homework.

In class the next day, after the children have figured out for themselves many of the factors that would slow the spread of new diseases, ask them to figure out how many pigs would have to be imported to change this ineffective play in the New World.

Smallpox was just one of the Old World diseases that took terrible tolls among New World people.
After the children have had plenty of opportunity for discussion, have them conclude this section by writing the "Weird Postcard" on the Pull-Out Page. You can end the Lesson Plan here if you are out of time. Or you can develop these ideas further by moving on to Step 5.

Step 5: Human Population Growth

Now that your students have looked into several examples of fast-growing populations, you may want to have them conclude by turning to the human population, which began its dramatic upswing around 1650—in part because food plants of New World origin (most notably potatoes and corn) dramatically increased the food supply worldwide.

Here are some approximate world population figures:

- 4000 B.C. 15 million
- 1 A.D. 250 million
- 1000 A.D. 340 million
- 1650 A.D. 500 million
- 1750 A.D. 711 million
- 1850 A.D. 1,130 million
- 1950 A.D. 2,500 million
- 1970 A.D. 3,650 million
- 1990 A.D. 5,300 million
- During 200 A.D. 6,250 million (estimated)

First, have your students make a graph of these figures. Then ask them to write a short story about what they think might happen in the future because of this human population growth. Ask them to create two or three alternative endings for their story, and to describe what events took place to cause these different outcomes.

National Metric Week

Over 95 percent of the world uses the metric system of measure, yet many Americans are still inching along with our traditional systems. Use of metrics is not mandatory in the United States, but more and more businesses are converting to stay competitive in international markets.

To obtain a kit of useful posters, handouts, cards, and explanatory materials to use with your students write to:

Metric Program Office
U.S. Department of Commerce, Room 4845
Washington, D.C. 20230

... and celebrate National Metric Week, October 6-12, 1991!

Seeds of Change

The exhibition Seeds of Change, at the Smithsonian’s National Museum of Natural History from October 26, 1991 until April 1, 1993, examines the exchange of plants and seeds between the Old and New Worlds following Columbus’s arrival in the Americas in 1492. Themes include the effects of the introduction of potatoes and corn to the New World.

A traveling version of this show, organized by the Smithsonian Institution Traveling Exhibition Service (SITES), will be on display in cities across the United States. For information, contact:

Office of Public Affairs
Smithsonian Institution
Washington, D.C. 20560
Tel. (202) 357-2627.

Other Smithsonian Quincentenary Activities

For information about other Smithsonian events commemorating the 500th anniversary of the landing of Christopher Columbus in the New World, contact:

Office of Quincentenary Programs
Smithsonian Institution
1100 Jefferson Drive, Suite 3123
Washington, D.C. 20560
Tel. (202) 357-4790.

Bibliography

Books for Teachers


Books for Children


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Weird Postcard

Imagine that weeds, cattle, and smallpox germs can think ... and even write!
Imagine too that it is about 100 years after Columbus’s first trip, and you are one of these creatures, writing a postcard home. (The postcard too is a pretend situation, since there were no postcards back then.)

You want to describe what happened to your ancestors after they arrived in the New World. Because whatever you say has to fit on the postcard, you have to figure out what is absolutely essential about your ancestors’ experiences.

When you have figured it out, cut out the postcard and write your message, saying “we did this” and “we did that.” Then draw a picture on the back of the postcard to illustrate what you are telling about.

How Many Pigs?

In the years after 1492 (when Columbus arrived in America), European ships would often leave behind a pair of pigs on the islands they visited. They hoped that this pair would breed, so that when the ship came back to the island in the future, the descendants of this pair of pigs would be meat on the hoof.

How many pigs could they expect to find when they came back?

To make it possible to figure this out quite easily, imagine a very simplified situation (the reality would be far more complicated; later you will have a chance to discuss why):

- The ship leaves one pair of pigs, a male and a female.
- This pair produces three litters a year—one every 4 months.
- There are 5 males and 5 females in each litter.
- All females have a litter every 4 months.*
- No pigs die.

The ship comes back after 3 years. How many pigs do the sailors find?
Before figuring out the answer, make a guess:
My guess is that, in 3 years, there will be ______ pigs on the island.

*In reality, the females would not have any babies until they were about one year old. But to keep the math easy, we will imagine they become mothers at a younger age. This makes their population grow in almost the same way, but in our version the changes happen 4 months sooner. In other words, your answer at 32 months is similar to the real pig population after 36 months of unlimited growth.
The first 3 months have been filled in, as examples.

- After 4 months:
The females all give birth, producing a total of babies—of which ___ are female.
Now the total number of female pigs is: the ___ mothers + the ___ female babies = ___ females.

- After 8 months:
The females all give birth, producing a total of babies—of which ___ are female.
Now the total number of female pigs is: the ___ mothers + the ___ female babies = ___ females.

- After 12 months:
The females all give birth, producing a total of babies—of which ___ are female.
Now the total number of female pigs is: the ___ mothers + the ___ female babies = ___ females.

- After 16 months:
The females all give birth, producing a total of babies—of which ___ are female.
Now the total number of female pigs is: the ___ mothers + the ___ female babies = ___ females.

- After 20 months:
The females all give birth, producing a total of babies—of which ___ are female.
Now the total number of female pigs is: the ___ mothers + the ___ female babies = ___ females.

The Game of Survival

In a sense, every living animal and plant is engaged in a very complicated and serious game—the game of survival.

- Players. Every species—and every member of every species, whether microbe, plant, or animal—is a player in this game. They have no choice. If you are born, you play.

- Goal. The goal of the game is survival. There can be many winners, but not everyone can win.

For a species to survive, enough of its individual members have to survive, at least long enough to produce offspring . . . and enough of these offspring, in turn, have to survive to reproduce . . . and so on, generation after generation . . .

As long as it does this, the species is still in the game.

- Resources. All players are surrounded by nonliving physical conditions (like terrain and climate) and other living creatures (of all kinds: microbes, plants, animals).

To stay in the game, the player must succeed in finding in this environment the resources (food, shelter, safety from predators, etc.) that it needs to stay alive and reproduce.

- Moves. In this game, a living creature can make any moves of which it is capable. A move is any kind of behavior or the development of any new physical feature. As in chess, where each piece moves in a different way, in the game of survival, each species has a different set of moves. (Most birds can fly. Most fish can breathe underwater. A pufferfish can inflate its body to scare its enemies.)

How useful a move depends on what’s happening. If you are being chased through a desert by a predator, the ability to breathe underwater is no help . . . but the ability to fly may save you. On the other hand, if you come to a water hole, the ability to breathe underwater may allow you to escape even a flying enemy.

In other words, an adaptation (a move) isn’t good or bad in an absolute way. It’s good or bad in a particular set of circumstances. Evolution isn’t a climb toward perfection, but a series of adaptations to an ever-changing environment. What works in one set of circumstances may not work in another.
¿Qué Tiene que Ver el Juego de la Sobrevivencia con Colón?

La llegada de Colón en 1492 fue el inicio de un enorme flujo de seres vivientes del Viejo al Nuevo Mundo. La llegada de estas nuevas especies cambió dramaticamente la forma del juego en el Nuevo Mundo.

Cuando en un juego, alguien hace una movida tan extrema como esta, los otros jugadores tienen que encontrar nuevas formas de responder. Se da un período en que se producen muchos cambios. Pronto la forma del juego será muy diferente que la anterior.

Esto es lo que paso en los años que siguieron después que Colón paso ambos mundos en contacto.

Mientras vemos algunos de los ejemplos de las nuevas jugadas que ocurrieron, nos concentraremos en poblaciones (una población consiste en todos los miembros de una especie que viven en un lugar en particular).

En la medida en que una población participa en el juego, esta puede cambiar drasticamente—por ejemplo, volviéndose más grande o más pequeña, o extinguirse o migrando.

Por ejemplo, si su fuente de comida crece o si sus enemigos mueren, es muy posible que la población crezca. Pero si su fuente de comida disminuye, o sus competidores aparecen, o una epidemia se produce, entonces es muy posible que la población disminuya.

Estos son los tipos de seguimientos biológicos a partir de 1492 sobre los cuales aprenderás en este ARTE A ZOOLOGICO.

Una Postal Rara

¡Imagínate que las malezas, ganado, y los germenes del sarampión pudiesen pensar...e incluso escribir!

Imagínate también que en los siglos que siguieron, el barco dejó un par de cerdos, un macho y una hembra. El barco regresó después de tres años.

El barco dejó un par de cerdos, un macho y una hembra.
• Este par produce tres camadas al año—una cada 4 meses.
• Todas las hembras tienen una camada cada 4 meses.
• Ninguno de los cerdos muere.

¿Cuántos cerdos podrían esperar encontrar ellos cuando volviesen?

En los años que siguieron a 1492 (cuando Colón llegó a América), muchos barcos europeos acostumbraban dejar un par de cerdos en las islas que ellos visitaban. Los tripulantes de estos barcos esperaban que esta pareja de cerdos tuviesen crías, de tal forma que cuando el barco volviese a la isla en el futuro, los descendientes de estos cerdos pudiesen ser utilizados como ganado.

Cuántos cerdos podrían esperar encontrar ellos cuando volviesen?

Para solucionar este problema, imagínate una situación simplificada (imagínate la situación real sería mucho más complicada; luego tendrás la oportunidad de descubrir porque):
Los primeros 3 meses han sido calculados como ejemplos

- **Después de 4 meses:**
  La hembra de la pareja inicial da a luz 10 crías —las cuales 5 son hembras. A continuación, se considera que el número total de hembras es la suma de las hembras madre y las hembras crías. En este caso, el número total de hembras es 6.

- **Después de 8 meses:**
  Las 6 hembras dan a luz, produciendo un total de 36 crías —las cuales 18 son hembras. A continuación, se considera que el número total de hembras es la suma de las hembras madre y las hembras crías. En este caso, el número total de hembras es 216.

- **Después de 12 meses:**
  Las 216 hembras dan a luz, produciendo un total de 360 crías —las cuales 180 son hembras. A continuación, se considera que el número total de hembras es la suma de las hembras madre y las hembras crías. En este caso, el número total de hembras es 216.

- **Después de 16 meses:**
  Las 216 hembras dan a luz, produciendo un total de 360 crías —las cuales 180 son hembras. A continuación, se considera que el número total de hembras es la suma de las hembras madre y las hembras crías. En este caso, el número total de hembras es 216.

- **Después de 20 meses:**
  Las 216 hembras dan a luz, produciendo un total de 360 crías —las cuales 180 son hembras. A continuación, se considera que el número total de hembras es la suma de las hembras madre y las hembras crías. En este caso, el número total de hembras es 216.

- **Después de 24 meses:**
  Las 216 hembras dan a luz, produciendo un total de 360 crías —las cuales 180 son hembras. A continuación, se considera que el número total de hembras es la suma de las hembras madre y las hembras crías. En este caso, el número total de hembras es 216.

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**El Juego de la Sobrevivencia**

De una forma u otra cada ser vivo, animal o planta, está involucrado en un juego muy complicado y serio —el juego de la sobrevivencia.

- **Jugadores.** Cada especie —y cada miembro de cada especie, ya sea microbio, planta o animal— es un jugador en este juego. No tienen alternativa. Si nacen, juegan.

- **Meta.** La meta de este juego es la sobrevivencia. Pueden haber muchos ganadores, pero no todo el mundo puede ganar.

Para que una especie pueda sobrevivir, un número suficiente de sus individuos tiene que lograr subsistir por un cierto tiempo y, asimismo, pueden tener un número suficiente de estos nuevos miembros, también deberán tener el mismo tiempo para reproducirse... y así una y otra vez de generación en generación...

Mientras esto suceda, la especie continúa en el juego.

- **Recursos.** Todos los jugadores están rodeados por condiciones físicas inanimadas (como el terreno y el clima) y otros seres vivientes (de todo tipo: microbios, plantas, animales).

Todos estos elementos representan el medio ambiente donde cada uno de los jugadores juega el juego.

Para permanecer en el juego, los jugadores deben lograr encontrar recursos que sean común y los seres humanos juega el juego.

- **Movimientos.** En este juego, toda criatura viviente puede hacer cualquier movimiento que sea capaz de realizar. Un movimiento es cualquier tipo de comportamiento o el desarrollo de un nuevo movimiento. Como en el ajedrez, donde cada pieza se mueve de una forma diferente, en el juego de la sobrevivencia, cada especie tiene un conjunto de movimientos posibles. (La mayoría de los pájaros pueden volar, la mayoría de los peces pueden respirar debajo del agua. Un pez globo puede hincharse para espantarse a sus enemigos).

Cuan útil es un movimiento en función de qué es que está sucediendo. Si un animal terrestre te esta persiguiendo en el desierto, la habilidad de respirar bajo el agua no es una ayuda... pero la habilidad para volar puede salvarle. De otro lado, si te encuentres con un estanque, la habilidad para

respirar bajo el agua te podría permitir escapar aún de un enemigo volador.

En otras palabras, una adaptación (un movimiento) no es bueno o malo en términos absolutos. Es bueno o malo en un conjunto de determinadas circunstancias. La evolución no es un ascenso hacia la perfección, pero una serie de adaptaciones al medio ambiente. Lo que funciona en determinadas circunstancias puede que no funcione en otras.

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*Ejemplo de la movida de una papa en el juego de sobrevivencia.* 

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