

EVOLUTION IS FUN

A collection of games
for the experiential education
of evolution and ecology
in high school





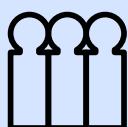
Why should we play? And how?

Playing and playfulness are fundamental human traits, playfulness is our evolutionary heritage. Children spend most of their time playing, or would do so if they could. Playing is a safe way to form and maintain social relationships, and an opportunity for learning and trying out new situations and roles. Numerous experiments prove that learning is most effective when coupled with positive experiences. If we are playing good games and do it well, we can learn and feel ourselves good at the same time.

The most important is to provide a trusting and supportive environment. This is absolutely necessary for players to join with all their heart and attention. Naturally it is also important that we tell the rules in great detail and precision every time. Always make sure that every player understands the rules and feels comfortable playing. Usually it is worth warming up the group with a quick game, so as to move them from the usual atmosphere of the school or other everyday activities to the world of playing. Our website presents a couple of such warm up games too. We also suggest to discuss the personal experiences and observations after each game. What was surprising or challenging in the game? What was the best strategy? What would you do differently if we played the game again? Following this, you can discuss the biological background of the game in detail.

Legend:

recommended
number of players



10-20

recommended
age range



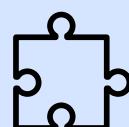
10+

time required:
preparation + game



5 + 10

complexity
of tasks



3 / 5

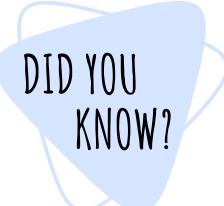
Warm up games

Paparazzi and bodyguard. We ask each participant to secretly choose a paparazzi (who desperately wants to take a photo of them) and a bodyguard (who will defend them from the paparazzi) from the others. Then we ask the players to move around in a way that their bodyguard always hides them from their paparazzi. (Here, usually a funny circular running starts.) Then, on the sound of a clap, everybody stops and tries to guess whose paparazzi and/or bodyguard they were. There should be time for quite some running and laughing before the clap. The game requires room: it is best played outdoors.

Jump in, jump out. Form a circle and hold hands. When the gamemaster says "jump in", then everybody jumps towards the centre of the circle with both feet, and at the same time repeats the instruction ("jump in"). Similarly, we perform and repeat the instructions "jump out", "jump left", and "jump right". This is too easy! So here comes the trick: players still have to repeat the instruction as the gamemaster said, but now they have to do the opposite. For example, when the gamemaster says "jump left", the players shall say jump left, but at the same time they have to jump right. Naturally, they should keep holding hands. As the instructions become more frequent, players will find them challenging to follow, and may make mistakes. Never mind! But once they grow accustomed, the gamemaster shall introduce further rules, e.g. "jump up" and "jump down" (crouch). Players will have to do the opposite, like before. Further complications are possible. The space requirement in that of the original circle.

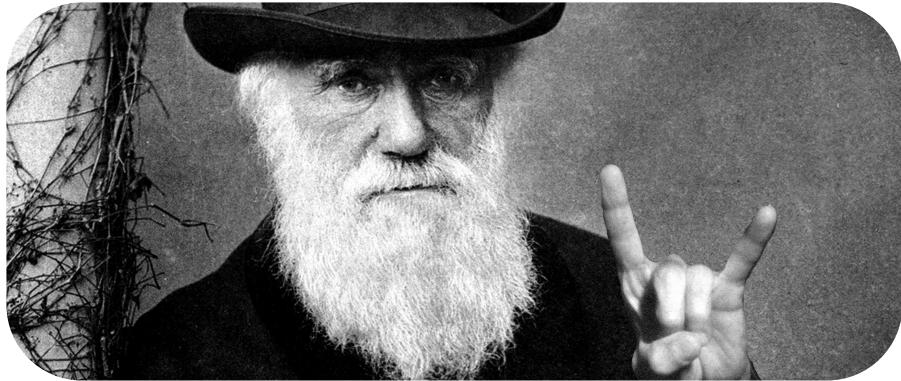
Electricity. Players are divided into two groups with an equal number of players. When there is an extra player, they will do the start; otherwise it is the gamemaster. Each group forms one of two parallel lines, holding hands. The two lines stand facing each other. We place a plastic bottle (or any other catchable object) on a chair at one end of the lines in a way that both players standing on that end can catch it. The game will start on the other end of the lines. Whoever starts will take the hand of the two players at that end of their respective lines. The instruction is the following. Everyone shall close their eyes. When they feel one of their hands squeezed, they should squeeze their other hand. The aim is to transfer the signal as fast as one can. When the signal reaches the player at the end of the line, they may open their eyes to try and catch the bottle. For the next round, catchers move to the beginning of their lines, and thus a new pair will be catchers. The game lasts until everyone had the opportunity to play catcher. We may keep track of the score, but the game is also fun without that. Enough room is needed to form the two lines.

Find further warm up games at www.evolutionisfun.hu/EN



DID YOU
KNOW?

When we are cold and have goosebumps, it does not help. But for our ancestors with dense fur, it formed an insulating layer around their skin and kept their bodies warm. For us, this reflex is a leftover of our historic past with no practical use.



Where is evolution heading to?

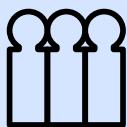
Introducing the key elements of the evolutionary process.

adaptation convergence speciation

Preparations. Players form a line or a circle, with 40-50 cm distance between neighbours.

Course of the game. The first player devises a preferably long and complex sentence and whispers it in their neighbour's ear. The second player passes it on towards the third player, and so on. When the last player receives the message, they say it out loud. Then the first player reveals the original message, so that we can compare the two. It is often funny how sentences transform. We can repeat the game with new sentences and new starting players.

Variations. (I) If we don't understand a word properly, we still have to pass on whatever meaningless voice we caught. (II) In the same situation, instead of a voice, we have to come up with a similar sounding word in a predefined topic (e.g. winter, summer, rain etc.). (III) We divide into two groups. The first player sets off the same sentence in both groups. These groups follow the rules of variant II, but with different predefined topics. For example, one of the groups substitutes the uncertain parts with words connected to summer, while the other group does this with words connected with winter.



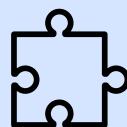
12-40



10+



1 + 15



1 / 5

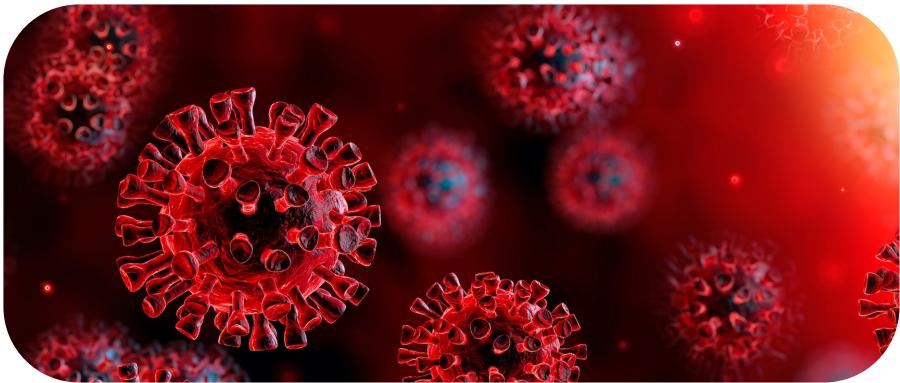
(IV) There are two groups, just as in variant III, but now they start with two different (equally long) sentences. Whenever uncertain, both groups substitute those parts with words connected to the same predefined topic, e.g. winter. (V) Two or more groups start with the same sentence. Transmission may follow the basic rules, or that of variants I or II. They compare results. The basic game and all of its variants may be played in 15 minutes.

Biological background. The game demonstrates the most important elements of evolution. Evolution by natural selection works in the following way. There are units capable of replication, i.e. making copies of themselves. They preserve their characters by replication, but the copy is not always identical to the original unit. If some of the characters of the units affect the replication success and/or the survival probability of the units, then selection takes place in this system. Those units that replicate faster or live longer than the others will spread. That is, those who adapt better to the living and non-living environment will be more successful. (I) When our brains are not instructed to make sense of what we hear, the original sentence quickly loses all of its sense. Copying is dominated by inaccuracy not selection. (II) Once there is a well defined principle (an environment) to which we try to adapt, the message will conform to it eventually. (III) The two groups start with the same sentences, but adapt to different environments. As a consequence, the two final sentences will diverge. This explains the process of speciation: two populations of a species, when placed in different environments, may eventually evolve into different species. (IV) This version evokes the situation of two different species becoming alike under similar selective pressures. For example, succulent plants in remote locations of the Earth arrived at retaining water in a similar way. (V) The same sentence passes through several groups. We will get different sentences if there is no common principle of selection. However, with a common principle to adapt to, sentence evolution will likely lead to similar results.

DID YOU KNOW?

Evolution is not necessarily a slow process. Treating infectious bacteria with novel antibiotics can evolve resistant strains in a matter of years. Similarly, pesticides developed against insects may quickly lose their effectiveness as those become resistant.





Playful pandemic

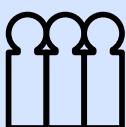
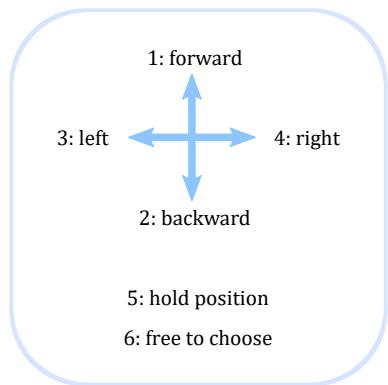
This game demonstrates the spread of different contagious diseases, borrowing features from real-life pathogens. Aggressive or docile; fast spreading or latent; variable or long-lasting in the wild; you will find them here!

contact spreading #stayathome

Accessories.

- 1 wearable status indicator card per player, with red "infected" and white "healthy" sides
- 1 die per player
- 1 display of movement rules →

Preparations. You will need a 5×5m playing field with clear boundaries, either in- or outdoors. The gamemaster draws, or posts, the movement rules at a visible spot (e.g. on the blackboard). Players are given their dice and their status indicators. Everyone is healthy at the start of the game: all players should wear their cards with the white side facing outwards.



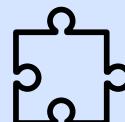
20-40



10+



5 + 10

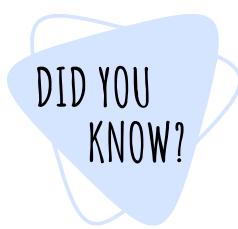


1 / 5

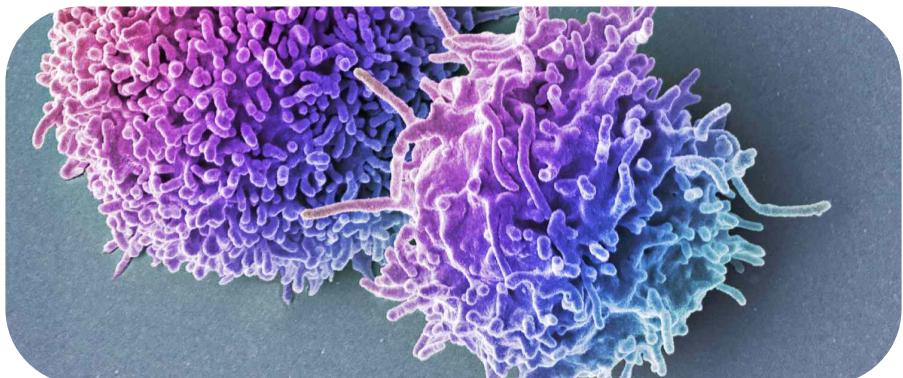
Course of the game. The players scatter across the playing field. The gamemaster appoints a "zero patient", who shall flip their status indicator to its red (infected) side. From then on, two stages will alternate: movement and infection. Movement consists of everyone throwing their dice (e.g. on the ground, squatting), and taking a step in the respective direction (1: forward, 2: backward, 3: left, 4: right, 5: none of them, 6: any of them); small kids may take two steps. Reaching the perimeter of the field, one rebounds. Infection consists of those infected turning around, and touching everyone within reach. Those who become infected shall now flip their indicators to red. The game lasts until everyone is infected.

Variants. Let us replay this game with a key difference: there will also be recovery! The players shall scatter again, and start the game with a single infected player. The state of being infected will last for two rounds (the 1st and 2nd rounds after getting infected). Then they recover, and become immune until the end of the game. This may be indicated by taking off the card (and holding it in one's hands). The game ends when noone is infected. Let us count the number of recovered players, i.e. those who have caught the infection, and see whether anyone have steered clear of it. This variant may be replayed several times to make apparent its randomness: it should help realize how unrealistic it is to expect authorities to accurately predict the size of a pandemic. Now, infections lasting a single round may also be explored (cf. aggressive disease, like ebola). The pandemic will fizzle out more easily this way. Each game takes about 10 minutes to play. Preparations are only needed once. Further variants are available at www.evolutionisfun.hu/EN

Biological background. Pandemics may be best understood through their elementary processes. Their biological characteristics and social intervention determine their spreading success.



The adaptive immune system is a peculiar evolutionary innovation of vertebrates. It sustains an astronomical number of different immune cells. When faced with intruders, the system selects and multiplies those cells that best attach to them. After the threat subsides, the pool of immune cells shrinks to its original size. This is an evolutionary innovation co-opting the principles of evolution.





Save our frog souls!

Frogs need to get from the woods to the lake, but there is a road with heavy traffic in their way.

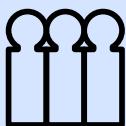
habitat loss

nature conservation

Anthropocene

Course of the game. Assign the players into two groups: frogs and cars. On a playing field of at least 5×5 meters, frogs will start in one corner, the woods, and aim to reach the opposite corner, the lake. Between them runs the road, a straight line through the middle, with a lane in both directions. The cars are on this road, starting no matter where, walking at a steady pace. When they reach one end of the road, they return on the other lane. On the gamemaster's cue, the frogs start their journey towards the lake at a slow pace, e.g. while squatting. Whenever getting in contact with a car, frogs get run over and leave the game. As realistic and fair, neither the cars nor the frogs shall change their pace to catch or evade the other. Also, cars should be gentle when running over frogs. The first round shall feature a single car, everyone else playing frogs. The following rounds shall see the number of cars increase, noticing how this affects the success rate of frogs. Each round will take at most 5 minutes to play.

Variation. The gamemaster may appoint one or two rangers whose job it is to save frogs. Rangers can stop any of the cars, one at a time, but cannot hold them back for more than a minute. Rangers may move freely. Whenever frogs get overrun, they may start the game again from the forest, as new individuals.



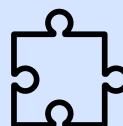
10-30



6+



0 + 5



1 / 5

Biological background. As humans encroach upon ever larger portions of the natural environment, a growing number of species and populations face the fragmentation of their habitat. A dramatic example is frog migration. Most adult frogs are terrestrial, living e.g. in fields or in woods. But they mate in e.g. lakes or backwaters, so that their larvae, tadpoles, can live in water. This essential need for water drives migratory frogs to travel long distances, often returning to their place of origins. On their way back, they may have to cross a road or two. There are more than 1800 vulnerable, endangered or critically endangered frog species, according to the IUCN. But instead of being left to reproduce safely, many get run over by cars, often en masse. Fortunately, Hungary has a number of organizations involved in frog rescue. In their campaigns, they install fencing to divert and accumulate the frogs, and then help them cross the road by various means, e.g. manually, or by constructing an underground tunnel. They regularly enlist the help of scores of volunteers.

DID YOU KNOW?

Though the number of extant species is huge, estimated to be 8-9 million, this pales in comparison to the number of those extinct. One of the largest mass extinction events takes place just now.





Hawthorn or blackthorn?

We are birds in the autumn forest. We may eat hawthorn or blackthorn. The former is more nutritious, but will get rare if all the others are going for it. So which one should we choose?

foraging strategy

equilibrium

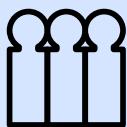
behavioural ecology

Accessories.

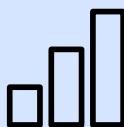
- 1 calculator
- 1 board and compatible pen
- pen and paper for all players

Preparations. After distributing pen and paper, the gamemaster shall introduce the story. Each player is a hungry bird. In autumn, their choice is hawthorn or blackthorn. The former is twice as nutritious. But neither is just ours: if everyone eats hawthorn, then our share will be meager. Our aim is to collect the most energy—this will earn us the highest score. So how should we choose?

Course of the game. Each player decides independently which resource to go looking for. Then, they shut their eyes and raise their hands with or without holding a pen, respectively indicating a choice of hawthorn or blackthorn. The gamemaster counts the size of both groups, and writes it on the board. Players take their hands down and open their eyes. Those who chose hawthorn will have a score of 100/their number. Those who went for blackthorn will have 50/their number.



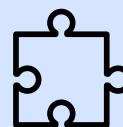
10-40



10+



2 + 10



2 / 5

For example, 18 players choosing hawthorn will get $100/18=5.55$; the remaining 11 players choosing blackthorn will get $50/11=4.55$. The gamemaster will ask every player to write down their individual scores for the turn. The game ends after 10-15 such turns, and the player with the highest total score becomes the winner. Applaud them! Also, let us retrace how much points did the two resources offer over the turns. These two values are expected to converge by the end of the game. Also, hawthorn will be chosen by about twice as many players than blackthorn. Discuss why this should be the case, and whether it is indeed. What kind of strategies were followed?

Biological background. Just like players, animals aspire to choose the resource offering the greatest gains from the available repertoire. But its eventual value depends on both its quality and the number of competitors. As demonstrated by the game, it makes sense for animals to constantly, and independently, experiment with both resources. They assess where they fared better, and switch until the gains equilibrate over the two resource patches. Natural selection has shaped the strategies of food exploration so that animals can find this optimum quickly.

DID YOU KNOW?

Ginkgo biloba, or maidenhair tree, is neither a fern nor a pine. Instead of a cone they have small yellow fruits, which emit a smell of urine but are edible and even tasty. They have separate sexes: their trees are either female or male.





The Common good, the Bad & the Ugly

Groups of players each manage a common resource (e.g. forest, fish stock, herd). Players may harvest as much as they wish from the commons. But this affects the renewal of the resource, which relies on the resource pool left untouched. What shall we expect? Will overexploitation erase the commons, leading to an ecological catastrophe, or will society learn to consume sustainably?

overfishing

sustainable consumption

optimal yield

Accessories.

- 1 card with table of renewal rates →
- 5 boards: A4 drawings of e.g. lake or forest
- 5 × 50 resource tokens, e.g. pebbles
- 5 containers for resource tokens
- 5 starting player markers (within groups)
- 5 notepads for taking log of stock size and points
- 5 pens or pencils
- 1 coin (or die)

resource pool	renewal
0-1	0
2-4	1
5-8	2
9-12	3
13-17	5
18-22	8
23-28	10
29-33	8
34-38	5
39-42	3
43-46	2
47-49	1
50-	0



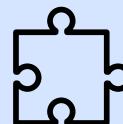
8-25



15+



5 + 25



3 / 5

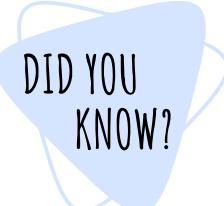
Preparations. You will need one table per 4-6 players. Place on each table a board with 25 resource tokens, a container with the remaining 25 resource tokens, a starting player marker, and a notepad with a pen! Players take their seats. The gamemaster explains the rules of the game, then takes the card with the renewal rates, which will be kept concealed from the players.

Course of the game. Each group plays separately. The game consists of 10-15 rounds, the exact number of which is unknown (see later). Each round consists of two phases. The first one is the harvest. Beginning with the starting player, players follow one another CW. Everyone may choose one of two actions: whether to take a single resource token from the board; or to settle with what they have. Those who settled will not perform any further actions in this phase—which lasts until all players of the group have settled. The starting player logs the size of each player's harvest, and calculates personal totals; these tokens are put in the container. The second phase is renewal. The gamemaster is called to repopulate the board with resource tokens (from the container), based on the hidden rules. This ends the round. The starting player marker is passed on CCW. Rounds 11-15 each take place with 50% certainty; only if the gamemaster gets a head on throwing the coin (or rolls an even number with the die). At the end of the game, players calculate their score: the total personal harvest (tokens collected throughout the game) added to the surviving stock (tokens left on the board). If group sizes are different, a correction takes place: the total personal harvest is multiplied by the number of players in that group. The player with the highest score wins. See further versions of this game at www.evolutionisfun.hu/EN!

Biological background. Exploiting common resources is, and has always been, a major dilemma in both animal and human societies. In these situations, selfish, exploitative behaviour is the profitable strategy, despite the fact that it leads to resource depletion and collapse. Numerous experiments, games and real-world observations show that without regulatory mechanisms, selfish, exploitative behaviour dominates. This is called the “Tragedy of the Commons”.

The exploitative behaviour of human societies has now reached such proportions that it endangers the entire biosphere. Examples abound. Overfishing has led to the disappearance of species, such as the bluefin tuna from the Atlantic, and the Black and Caspian Seas. The atlantic cod is next in line. Excessive deforestation has led to ecological disasters, which in many cases were followed by social disasters.

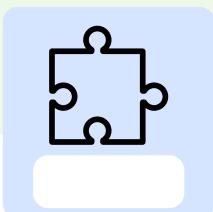
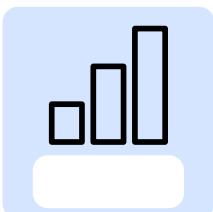
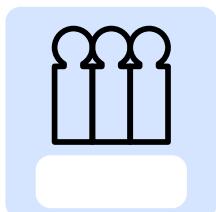
Managing common resources is one of the greatest challenges of our modern, global, profit-driven society. Different systems of norms, value systems removed from purchasable power, honest communication between parties, punishment of exploitative behaviour, and uniform regulations can all help create a more sustainable future.



DID YOU KNOW?

When doing good to fellow humans, and when punishing cheaters and social norm violators, our brains activate the same reward centers.

Design your own game!



Notes



The creative team



Gergely Boza PhD



András Hubai MSc



Judit Mokos MSc



Viktor Müller PhD



István Scheuring DSc



Zsóka Vásárhelyi PhD

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This booklet and the accompanying website, evolutionisfun.hu, owes its existence to the generous funding of the European Society for Evolutionary Biology (ESEB).