

Playing with the theory of Evolution... or not?

Previous compulsory steps / Prior students' knowledge	Basic principles of the Theory of Evolution (Darwin), and Lamarck's views/ideas about the evolution of species
Learning objectives	Familiarizing students with the theories of Evolution, Biological adaptation, and Natural selection
Subjects	Biology, Theory of Evolution
Recommended Age	15-18
Material needed	PCs that can run the game "Spore"
Sequence duration	135 minutes
Individual or group activity	Single Game Player in group activities
Skills developed	Creativity, problem solving, teamwork
Price range of the game	19,99€ (<20€)
Similar games to use with the approach of the sequence	Species: Artificial Life, Real Evolution
Tips for inclusion	In "Options/Settings" menu there are a lot of settings (to change/adjust) to help people with various disabilities.
Tips for shortening the duration of the sequence	It is essential to discuss the Theory of Evolution in class, so no shortening of the sequence is possible due to the topic of the activity.

Step by step: how to implement the sequence

The theory of Evolution is difficult but crucial for scientific thought and the subject of biology. And as Herrero & del Castillo, 2013 note: “The main principles and ideas associated with Darwinian evolution may conflict with personal, social and religious beliefs, leading to erroneous conclusions that do not conform with scientific understanding”. So, it is important to approach this important subject educationally in multiple ways. In this pedagogical sequence, students are going to use video game “Spore”. The game has four different stages. The first two stages (cell and creature) relate more to biology concepts and the last two stages are referring more to sociology and society’s concepts of species. In this pedagogical sequence we are going to use mostly the first stage and assign homework with the use of second stage.

- **Step 1: The educator reminds students of the key points of the Theory of Evolution (15 minutes)**

In order to place them in the context of the theory of evolution educator should remind the students of the basic principles of the theory (as it “prepared” by Lamarck’s views on the “evolution of species” and formulated by Darwin in “On the Origin of Species”) and will specifically address the concept of natural selection associated with the struggle for survival and the characteristics that are favorable for species to adapt to the environment in which they live.

- **Step 2: The educator creates groups of students and explains the process to them (10 minutes)**

The educator divides the students into groups of three (according to the rules for dividing students into groups, laboratory school practices). They then explain the process of the game, starting the game and giving a brief presentation on the basics of handling the game. In addition, they state the core objective of using this particular game, which is to highlight the conventions and differentiations of the game from the scientific approach to the theory of evolution. The game is a simulation software and, like any simulation software (whether designed for education or not), has inherent limitations and simplifications that inevitably lead to differentiations of what it contains and projects from the science to which it refers.

Through the students' highlighting and identification of these differentiations, and their discussion thereafter, it is hoped that the building of a concrete and scientifically correct view of the theory of evolution and its parameters will also emerge.

- **Step 3: Discovering the game and discussing it in groups (45 minutes)**

Depending on their initial role, the students play the game, record their actions and communicate with the teacher as needed during the game. It is advisable to rotate these roles as the game progresses. The game starts from the cell stage. The cell stage simulates microscopic life.



Figure 1. Snapshot of game – The Cell Stage. ("Spore", EA Games, 2008)

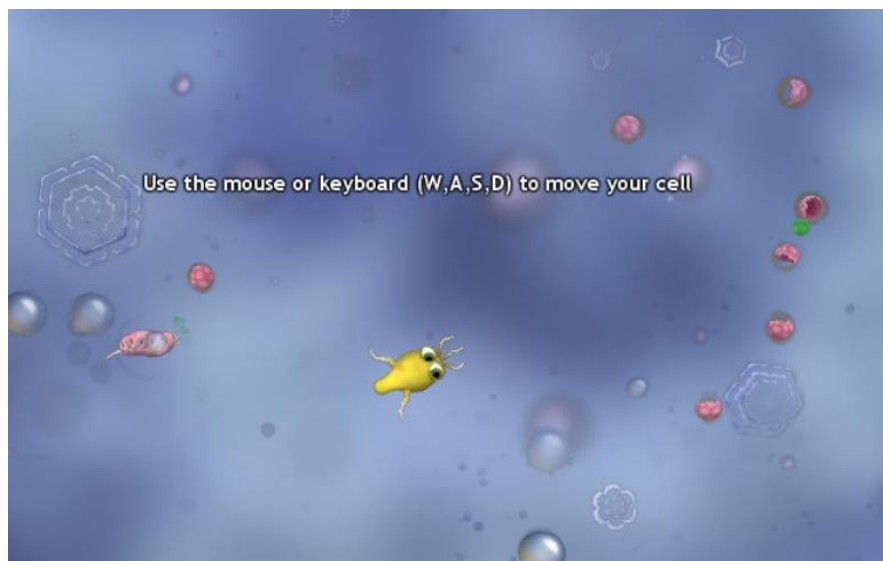


Figure 2. Snapshot of game – Our Protagonist in the liquid environment. ("Spore", EA Games, 2008)

The students playing the game will work with the members of the team recording as if in the form of a small "diary of actions" or a log of the phases of their game. In this log, at each phase of the game (where something new happens that requires the player's decision), they should record what they did. Then, and after discussion within their

groups, they will judge the game against the scientific view and record the group's view on it.

For example, in the game the player, in a few minutes, differentiates the genre he is playing with. Such a change would take millions of years in real life. In the game, this is not explicitly mentioned but is shown in a menu (as seen in the image below).



Figure 3. Snapshot of game – Millions of years passing in minutes. ("Spore", EA Games, 2008)

Another example (and topic of discussion) is adding attributes to the creature as a result of user choices. As we know, characteristics exist in species and are inherited from parents to offspring through reproduction and are differentiated through mutations. Individuals with traits that in a given environment are conducive to adaptation continue to exist and reproduce, while individuals with traits that are not conducive to adaptation in that environment gradually disappear.

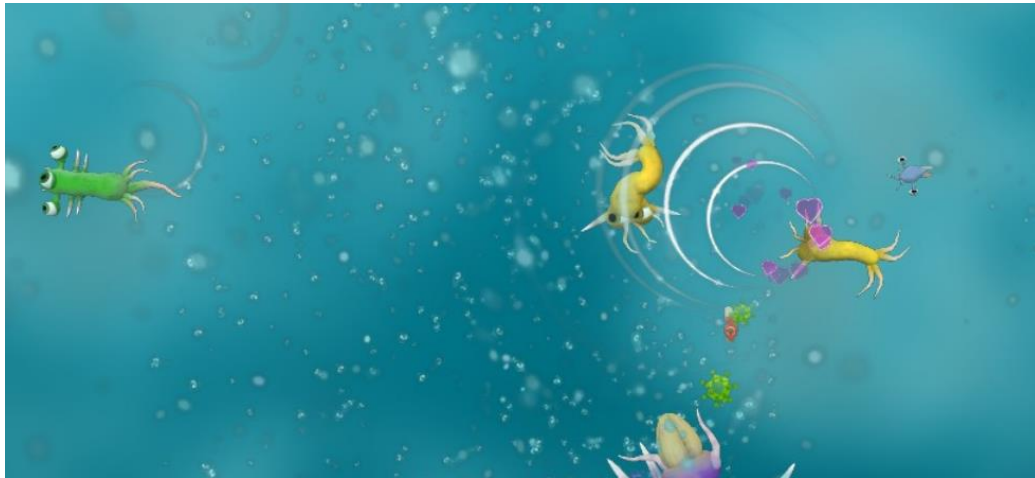


Figure 4. Snapshot of game – Mating process. ("Spore", EA Games, 2008)



Figure 5. Snapshot of game – Evolution of species after mating. ("Spore", EA Games, 2008)

A final example of discussion concerns the addition of characteristics by the game player (e.g., from a God or Nature or from Someone or Something else;) and whether it is compatible with the scientific point of view.

In the below snapshot from the game, we see the addition of legs after the process of completing the phase of "evolution" from a micro-entity living in liquid to an entity on land, where the original form is maintained with the addition of legs by the player.



Figure 6. Snapshot of game – Adding legs ("Spore", EA Games, 2008)

In the next step of the pedagogical sequence, the most important issues that arise during the development of the game are mentioned. The educator should have these in mind from the beginning in order to make some limited relevant references in the first step of the pedagogical sequence, if they think it is necessary.

- **Step 4: Classroom reflection about scientific concepts (45 minutes)**

Each group (through a representative) reports to the class plenary their experience of the first cycle's game. The educator records the main points of change in the game as reported by the representatives of the student groups.

The educator will discuss with the students in the plenary (during the recording on the whiteboard and afterwards) the key points in relation to the theory of Evolution and the differentiation of the game around them, always in relation to the game the students played. Our aim is to highlight these differentiations in order to reinforce to the students' understanding of the scientific framework and the individual elements around species evolution, natural selection and biological adaptation.

On the whiteboard, the teacher divides the species into two categories: herbivorous or carnivorous. In fact, in the end, the "behaviors" of the two species in the process of evolution are compared.

The recording on the whiteboard will allow for discussion and clarification of any of the students' misconceptions in order to reinforce sound scientific thinking. Thus, discussions are held that address issues of sound scientific thinking on the following topics, such as:

- "Randomness" with a meteorite falling on a planet for the origin of life
- Battle for the survival of the species
- Two-dimensional representation of the first stage's protagonist's space of movement (different from our three-dimensional world)
- Reference or not of the game to the "population" of their species and not to an "individual" of the species,
- Changing the DNA in a random way
- Adding features and characteristics through interaction with other species
- Consumption of other species and results of that action in an "evolutionary" way
- Biological healing through eating food
- The result of reproduction contributing to the evolution of the species
- Diversification of the species in a few minutes
- Natural selection as a factor regulating evolution
- Collection of genetic material

- **Step 5: The educator sums up (20 minutes)**

In this step, the educator sums up and clarifies possible misconceptions regarding the established theory of evolution by giving a complete picture of the theory of evolution on the whiteboard. This will be based on the previous step (3). The educator also answers any remaining questions.

- **Step 6: The educator proposes the next stage for homework (5 minutes)**

The educator assigns the next stage of the game (the creature stage) as homework for students. In the second stage, the protagonist of the video game becomes a land creature. On land, the main activities are eating and collecting genetic material (Herrero & del Castillo, 2013).

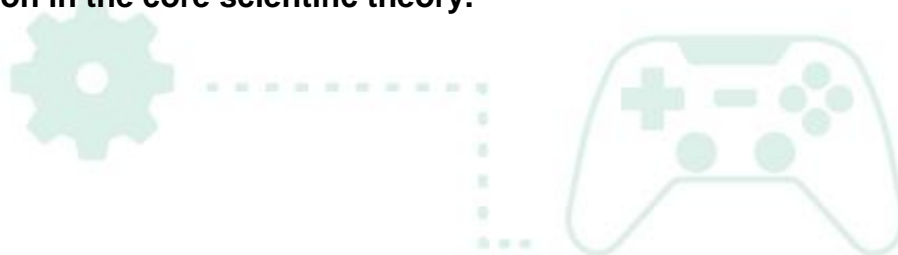


Figure 7. Snapshot of game - The transition from the liquid environment to the land. ("Spore", EA Games, 2008)



Figure 8. Snapshot of game - The first moments in the “creature stage”. (“Spore”, EA Games, 2008)

Note: Steps 1 to 5 could be repeated for the next two stages, but with differentiation in the core scientific theory.



Getting the game:

https://store.steampowered.com/app/17390/SPORE/?l=english&curator_clanid=33088125

Manual of the game:

<https://cdn.akamai.steamstatic.com/steam/apps/17390/manuals/manual.pdf?t=1617905702>

References:

Bean, T.E., Sinatra, G.M. & Schrader, P.G. Spore: Spawning Evolutionary Misconceptions?. *J Sci Educ Technol* **19**, 409–414 (2010).

<https://doi.org/10.1007/s10956-010-9211-1>

Cavanagh, Sean. “Spore’ Plays Games with Evolution Theory.” Education Week, Education Week, 14 June 2021, <https://www.edweek.org/teaching-learning/spore-plays-games-with-evolution-theory/2009/01>

Encyclopædia Britannica, inc. (n.d.). Encyclopædia Britannica. Retrieved December 16, 2021, from <https://kids.britannica.com/kids/article/evolution/353115>

Herrero, D., & del Castillo, H. (2013). Can a failed simulation game be useful for teaching about reality that it aims to simulate? Learning evolution and natural selection through spore video game in a biology class. in *Edulearn13 proceedings* (pp. 957-965). IATED.

Students Book of Biology Third Lyceum Class.

http://ebooks.edu.gr/ebooks/v/html/8547/2724/Biologia_G-Lykeiou_html-apli/index3_1.html

