Education Arcade: Build-a-Tree

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Abstract

In order to increase public understanding of evolution and life on earth, a team of computer scientists, biologists, learning scientists, and museum staff partnered to create *Build-a-Tree* (BAT). BAT is a multi-player puzzle game played on interactive tabletop surfaces in natural history museums. BAT has been on display at the California Academy of Sciences since October 2012 and has been played by thousands of visitors. It was developed to help players understand the proximity and distance of species relationships through their shared—and not shared—traits. In order to level up, players must drag-and-drop icons to assemble scientifically-valid trees that show particular species inheriting certain traits while others do not. BAT is designed to encourage experimentation, collaboration, and reasoning about the evolutionary relationships between species. See a video demo of the game here: http://vimeo.com/97068984.

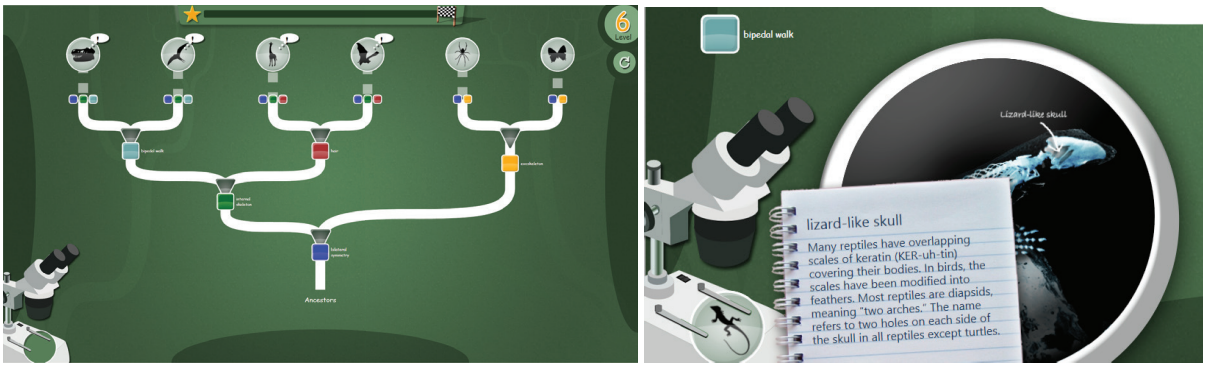

Figure 1. Build-a-Tree is a multi-level phylogenetic tree-thinking game with a microscope tool (right) that helps players learn more about the organisms in the game and their shared traits.

Evolution in Everyday Life

Evolutionary theory is a central organizing principle of modern biology and has far reaching implications. For example, recent innovations in farming methods have their origins in our knowledge of evolutionary principles (Forbes, 2006). The increase in pesticide-resistant agricultural pests is the direct result of natural selection; this has informed the design and development of new pesticide formulations intended to protect crops from insects and disease (Forbes, 2006; Driver, Leach, Millar, and Scott, 1996). Evolutionary concepts such as adaptation and mutation have also helped to answer many questions about diseases such as influenza, HIV, and cancer and have led to the identification of new drugs that assist in both detecting and treating these diseases (Forbes, 2006; Smith, 2010). Unfortunately, repeated studies have shown that the general public has difficulty understanding and accepting the basic mechanisms of evolution (see Rosengren et al., 2012).

Interactive Tabletop Surfaces

Interactive tabletops have gained increased attention in recent years and researchers and educators alike are interested in their use for science learning. Tabletops allow multiple users to interact concurrently, which supports collaborative learning. The tabletop's ability to "support awareness of other's actions and [their] ability to support concurrent input" gives agency to every engaged learner while providing incentive for individuals to interact with each other (Rick, Marshall, and Yuill, 2011).

Build-a-Tree: In Action

Build-a-Tree is an interactive, tabletop puzzle game that tasks players with building an accurate evolutionary tree (also known as a cladogram). The game provides players with circular species tokens, square trait tokens, and triangular branching tokens (see Figure 1). A microscope is also available for the players to use at their discretion; when a species token is placed onto the microscope, information about that species' traits, along with images, is given to the player (see Figure 1). Players must build trees step-by-step, creating branches then placing species and trait tokens on those branches based on the traits they have in common.

When a trait is correctly "inherited" by a species, the species token displays a green check mark and a star appears in the progress bar at the top of the screen. Otherwise, a red X pops up on the species token. If a species is missing a trait, it will display a black exclamation point. There are no points or progress lost for incorrect trees, nor is there a timer to limit gameplay at any level. This encourages players to experiment without fear of being penalized. Players are thus free to rearrange tokens and debate the arrangement of species and traits amongst themselves, encouraging collaboration and dialogue that lead to the construction of scientifically-valid trees, allowing them to move to the next level.

This version of BAT is a second revision based on the results of a comprehensive research study that demonstrated the need to make traits more explicit in the gameplay. We are currently testing BAT with museum visitors. While we are still in the preliminary stages of our evaluation, we look forward to sharing our initial findings with the GLS community.

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