EVOPIX: A web game to teach basic genetic and evolutionary concepts

**Abstract:** To support the development of a web application that utilizes genetic algorithms to create vector graphic images, and to convert this application into a public online game and a classroom tool to teach evolutionary theory.

**Background and Significance:** Interactive evolutionary games have significant potential to introduce evolutionary concepts to a broad audience, but existing platforms are either simplistic and inaccurate (PicBreeder, Image Evolution) or complex and impersonal (Avida-Ed, Darwin Pond, Gene Pool). Moreover, there is no existing evolutionary game that utilizes the flexibility and accessibility of the Web to facilitate player retention. A simple, addictive Web-based evolutionary game offers the opportunity to introduce basic concepts in genetics and evolution in both a classroom setting (for use in BEACON’s existing educational programs) and in a global social networking context.

**Preliminary results:** Stephen Bond has developed the ‘Evopix’ Web interface to incorporate selective breeding of vector graphic images. Inheritance, mutation and speciation are already integrated, and genealogy is fully recorded. A 1-month beta session with 10 volunteers generated 34,000 offspring starting from a single ancestral pair of images, and users found the site addictive enough to return daily. (URL, movies, etc.)

**Specific Aims:** We propose a short-term project to both integrate Evopix into a classroom setting as well as develop it further within a public social networking context. Specifically, **(1) Continue developing Evopix to provide a robust, friendly set of Web-based interfaces to introduce heritability, random mutation, unequal survival, and the accumulation of small changes over time.** The current Evopix site implementation requires aesthetic upgrading and extension to work with more browsers, as well as further testing and optimization. **(2) Design, develop, and implement Evopix-based microcosms, lesson plans, and associated assessments for junior high, high school, and undergraduate classes.**  We will build isolated and controllable instances of Evopix that can be used within a classroom setting, along with assessment plans to study the effect of Evopix on students. **(3) Extend Evopix to include a global social networking component, focusing on “viral” growth, user retention, and competitive and cooperative modes of social interaction.**  We will make an Evopix “world” instance available to the general public. Competition for generating popular breeds will be motivated by a simple economic model based on breeding rights, while collaborative breeding efforts will be encouraged through an incentivized voting structure that influences assigned fitness within a ‘naturally’ breeding population, thus generating a rich and complex fitness landscape. **(4) Train Stephen Bond in designing and delivering educational content, and designing assessments at all levels.**

Starting September 2012, we will require five months to build a production ready user interface for Evopix, develop lesson plans, and train Stephen as an instructor. We will implement an in class pilot program consisting of three, two week with a grade 9 science class in the winter 2013 term, including 6-10 hours of in-class instruction on using the game and evolutionary theory. The students will be assessed on their knowledge every four weeks during the pilot to gauge the effectiveness of the material, and will be surveyed on their experience with Evopix. During the in-class pilot, we will begin advertising Evopix through social media to generate public interest in beta testing. Student feedback will be used to further refine Evopix, and a public beta will be released in the spring of 2013.

**(@Paragraph about your ~1 yr plans implementing the above, and some of the more coherent/cohesive ideas we’ve discussed.)**

Include replay, phylogeny, etc.

**Teaching**

Private instances of the evopix server will be created for classrooms to use over the course of a semester, allowing students to observe the initiation and divergence of an entire “microcosm”. A set of 6 lesson plans will be developed around the classroom evopix server: 1) Core principles of evolution, 2) phylogeny & taxonomy, 3) genotype vs. phenotype, 4) microevolution vs. macroevolution, 5) historical contingency, and 6) …. We will work closely with teachers to increase their own understanding of evolution, and to equip them with the resources and confidence to properly educate their classroom. Do we have a standing relationship with a school board we can tap here? @CTB Yes – just come up with ideas ☺

Two week sketch

Monday: Introduce evopix, and get everyone into the database with an account. Show the students the basic interface, but mostly just get them started so they can play with it for a couple of days before the ‘real’ lessons begin.

Wednesday: Core principles. Identify how mutation has occurred, and how those changes have been inherited. Explain the power of selective pressure, specifically the desire for something cool in the case of the evopix, and show the students the outcome of total random breeding starting with the same evopic their world started with. The contrast should be fairly obvious. Elude to the ‘genetic code’, but leave them hanging. All examples from evopix will be paralleled with real world ‘organic’ examples.

Friday: Describe the need for heritable material, and compare and contrast DNA to computer code. Taking care to explain that the underlying principles of evolution are not intrinsically connected to what we would classically identify with as ‘life’, but instead is a simple process that can occur wherever the core principles exist (include language as an example). Teach the class about phylogenetics, and the difficulties inherent in taxonomy. Hopefully the voting has begun on new species by now.

Monday 2: Speciation should be well underway, so micro vs macroevolution should be easier to convey at this point. Spend the time to clearly convey how one begets the other over time, and draw heavily on examples from the real world after identifying examples from evopix.

Wednesday: Natural selection vs selective breeding. Drive home that they are the same thing, just with very different selective pressures. Show how the wild evopix have changed relative to the popularity of the farmed evopix, and maybe bring in another tool like Boxcar2D to demonstrate natural selection quickly.

Friday: Historical contingency. Explain how replaying life’s history would not necessarily, or even likely, result in what we see today. This will be easier with the second class, since we’ll have the first classes evopix to show as an example of how things can turn out differently. Test the students on the material, and have them fill out a survey.