Supplement 2. Teachers Notes

How to Conduct this Activity in the Classroom

*Before this activity*

This activity introduces natural selection, inheritance, and mutation. Any previous exposure to these topics would of course make this activity more impactful. For example, studies have shown that college students are better able to learn evolution if they have already taken genetics. It follows that a basic understanding of genetics (in this case how parents pass on traits to their offspring) would help students understand natural selection. Thus students may get more out of this activity if teachers spend time on inheritance before students play the game. Additionally, a background on animals and their environments would be helpful; for example, understanding what a predator is, what a species is, what an environment it, the types of animals that might live on a coral reef, etc.

To prepare for this activity, instructors should first print activity booklets (Supplement 1) for each student in color if possible. Each group of 4 students will also need a die, 4 coins, safety goggles, and drawing utensils (e.g., markers, colored pencils, or crayons). Because coins are considered a projectile, students should wear safety goggles to protect their eyes when flipping their coin. This activity has three lessons that should take 30-45 minutes each. We suggest completing each section on a different day, but with no more than 4 days in between so that students do not forget what they have learned.

*Classroom management*

We found that groups of 4 were ideal, but an instructor could have a group of 3 or 5 if there is an odd number of students. An instructor could manage the class in two ways. First, each group could work at its own pace, which is mostly driven by reading speed. This is how we led the activity, and our students naturally took turns reading aloud. Eventually, the fastest readers took over most of the reading, so we encourage instructors to place at least one strong reader in each group. One advantage of this approach is that a teaching assistant could work closely with a group of students that works at a slower pace, for example if several students have individual education programs. The second option is for the teacher to read the instructions to the class and have all groups work at the same pace. This approach may be more effective if many of the students are learning English as a second language (ESL) or if students are in individual education programs. Another way that teachers could facilitate learning for ESL students is to go over the glossary before beginning the activity. Each of the three lessons has a glossary at the end of the activity booklet.

No matter which approach an instructor chooses, we strongly encourage going over the first 5 pages as a class. One thing that the students will need help understanding is step 2 where they choose an animal. Because each group of students represents a population of animals that can interbreed, they must all be the same type of animal--we do not want to teach misconceptions about different species interbreeding since the biological definition of a species is reproductive isolation. Thus, each group must agree on a type of animal that they will all be (e.g., turtle, starfish, jellyfish). We also discovered that it was best to explain the coin flipping for the first time as well as how to record each flip. Each student should have his/her own coin, and should flip it 5 times--each flip determines one trait type in the table going from top to bottom (step 3). Once students begin drawing their animal (with its randomly selected traits), they should be able to finish the 3 lessons independently. We further identified text-heavy sections (specifically pages 13, 15-16, and 18) in which the material goes beyond the instruction of regular gameplay and is critical to the understanding of the evolution concepts. As such, we highly suggests instructors lead their students through the following sections: pg 13 inheritance, pg 15-16 mutation, pg 18 mate choice. Additionally, we touch on the topic of climate change on page 30 of the activity booklet. If it fits in with instructors’ learning objectives, classrooms could benefit from further discussion on the topic. Overall, we advise instructors to use their discretion when it comes to the management of their classroom, gauging reading ability and planning extra instruction as needed, as well as engaging in more in-depth discussions of certain concepts depending on individual instructor goals.

*Formative assessment*

 There are three total rounds/lessons in which the students’ fictitious animals must survive: predation, mate choice, and climate change. At the end of each lesson, teachers could conduct formative assessments by asking students to answer questions with a show of hands and with short discussions. The simplest formative assessment would be for instructors to go over the questions that are already included in the booklet. Every few steps, students respond to questions in the booklet that relate to the learning objectives (Figure 1). An instructor could pause at each of these questions and ensure that all of the students understand before moving on. For example in step 6, students predict whether their animal will survive a shark attack. This would be a great place for a short classroom discussion about why the students think their animals will survive or not. Their responses should be based on the traits their animals have (from step 3). An instructor might also discuss the scoring system, for example that small size received more points than large size, but this may not be true if the animal were larger than the shark. Additionally, there are several questions at the end of each lesson (e.g., steps 8-11 for lesson 1) that could be discussed as a class. For example, step 11 asks students whether there would be variation in survival if all animals were identical. This question gets at a fundamental part of evolution--there must be variation on which natural selection may act. We would only expect to see differential survival based on traits if there is variation in the traits that the individuals in the population possess. Finally, if students have not learned about inheritance, it would be helpful to have a short classroom discussion at the beginning of lesson 2 since steps 13-16 introduce inheritance and mutation, which may occur when animals reproduce and their DNA is copied to be passed on.