Biology 4415/5415
Evolution

LABORATORY EXERCISE: SELECTION IN POPULATIONS

Charles Darwin opens *The Origin of Species* with a discussion of how humans have produced countless varieties of animals and plants by selective breeding. Humans can consciously produce new varieties of animals and plants with desirable traits, simply by picking out individuals that are close to the desired phenotype, allowing them to breed repeatedly, and culling out individuals that are not close to the standard. Darwin himself experimented a great deal with breeding fancy pigeons, and drew heavily on the writings of stockbreeders and horticulturalists in writing *The Origin of Species*.

MATERIALS:

- spoons, forks, and sporks
- plastic cups
- Kibbles'n'Bits brand dry dog food
- level ground
- tape measure
- stakes
- timer

PROCEDURE:

1. A square area about 5 yards x 5 yards is marked off behind the LSC.

2. Before each simulation, the square will be stocked with "food items" by your humble instructor. These vary in size, shape, and color; some will be easy to see on the grass, and others will probably be harder to see.

3. A group of students will act as organisms that feed on the food items ("feeders"). Each will be given a tool with which to pick up food items from the ground, and a cup in which to place them. There will be three types of tool: a spoon, a fork, and a spork. The exercise will begin with two students using each feeding tool type.

4. On the instructor's signal, the students acting as feeders will move into the square and begin collecting food items. Food items must NOT be handled with anything other than the feeding tools. Do NOT feed outside the boundaries of the designated square. Students who are not acting as feeders may act as "line judges" to monitor potential cheating.

5. Exactly one minute later, the feeders will stop collecting, and tally the number of food items found.

6. A feeder must acquire at least ten points in order to survive to the next round. Anyone who does not acquire ten points is "dead" and out of the game.

7. A feeder who acquires twenty points or more not only survives, but reproduces. Reproduction goes like this: The feeding tool in this simulation is governed by a single gene with two alleles, **A** and **a**, which show incomplete dominance**.** The spoon is **AA**, the fork is **aa**—and the spork is of course **Aa.** When it's time to reproduce, students will pair up randomly, and determine their "offspring"'s genotype according to Mendelian rules (two spoons pairing up will always have a spoon offspring; a spoon and a fork will always have a spork; a spoon and a spork will have a 50% chance of a spoon offspring and 50% chance of a spork, so they'll flip a coin; etc. etc.) The students then call in another student from the class to be their "offspring", with the determined feeding type.

8. All students then empty their cups into the instructor's cup. The instructor then "restocks" the feeding area, and the simulation begins again at step 4.

9. The instructor will keep a running total of exactly how many students of each tool type are present in each generation. This information is provided on the next pages.

10. For each experimental run, calculate **p** (the frequency of allele **A**) and **q** (the frequency of allele **a**) in each generation. Graph **p** and **q** on the y axis against number of generations on the x axis, connecting the points with straight lines; you don't need to try to calculate a linear regression or anything like that.

11. The lab write-up shall consist of four sections: an introduction, setting the context for what you did; a materials and methods section, very briefly and concisely describing what you did (especially if any changes were made from this handout); a results section (including your graphs); and your discussion and conclusions. None of these need to be longer than a paragraph or two. Grammar, spelling, punctuation, etc. all count. What I want to see in the final section is an attempt to raise and answer questions like: Was there a discernible trend in allele frequencies? If so, what might have caused it? Was it selection, or something else? How can you tell, or how could you tell with further investigation? Did you vary the rules of the game in any of the simulations? What effect did that have? Give me a serious attempt to grapple with your data and the issues that it raises.

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Selection Lab Data

ROUND 1:

	AA (fork)	Aa (spork)	aa (spoon)
1	1	2	1
2	0	2	2
3	0	3	3
4	0	3	5
5	0	5	7
6	0	7	8
7	0	6	9
8	0	5	12
9	0	5	12
10	0	3	13
11	0	3	14
12	0	3	13
13 (famine)	0	4	8
14	0	6	10
15	0	8	12

ROUND 2: In generations 1, 3, 5, 7, and 9, the Angel of Death randomly removed one player for every four.

	AA (fork)	Aa (spork)	aa (spoon)
1	1	2	1
2	1	3	0
3	1	4	0
4	2	4	0
5	3	5	1
6	3	4	1
7	4	4	2
8	4	4	3
9	7	5	3
10	7	4	3

Just for fun: This is the data from two different runs of the same experiment in Fall 2010. The main difference was that in fall 2010, we did the experiment by the cement table, in an area with lusher and more mixed ground vegetation. Analyze it in the same way that you analyze our class's data. How different is it? Why might it be different? What does this tell you about the validity of the experiment?

	AA (fork)	Aa (spork)	aa (spoon)
1	1	2	1
2	1	3	2
3	2	4	2
4	3	4	3
5	3	5	2
6	4	5	2
7	5	6	2
8	5	6	2
9	4	7	2
10	5	7	1
11	4	7	0

1	1	2	1
2	1	3	1
3	2	3	2
4	3	4	2
5	3	4	3
6	3	6	3
7	3	7	3
8	3	7	3
9	1	7	2
10	1	9	3