Exploring evolutionary mechanisms with Bingo Chips

Your team has discovered a new population of Bingo Chips that lives along the coast. This organism is haploid, meaning it only has one copy of each chromosome. It has one visible phenotype (color), which is determined by the Color Gene. Like budding yeast, Bingo Chips reproduce clonally via a budding process, resulting in two individuals who have the same genome and phenotype. They are exceptionally long-lived, meaning that each Chip can reproduce for many generations. Everything these Chips need to survive is on the coast – they can see an island off in the distance, but cannot reach it.

1. **Establish your own population of Bingo Chips** – **there will be 2 individuals of each color**.

Initial phenotypic ratios (remember to write in your phenotype colors):

Generation 1	Color 1:	Color 2:	Color 3:	Color 4:
Mainland population	2/8	2/8	2/8	2/8

Bingo Chips are haploid, so how many alleles does a single Bingo Chip have for the Color Gene?

How many alleles for the Color Gene exist in Population 1?

2. The Founder Effect

A rare low tide has exposed a temporary sandbar. Some curious Bingo Chips take this opportunity to explore the nearby island, but they're stuck there once the sandbar is covered.

- Move a few Bingo Chips of any color to the island (no more than 3).

After this tragic separation, each Chip will clonally reproduce one time.

- For each Bingo Chip on the island and the mainland, add another Bingo Chip of the same color to the same population.

Phenotypic ratios:

Generation 2	Color 1:	Color 2:	Color 3:	Color 4:
Mainland population				
Island population				

After reproduction, how do the **mainland** phenotypic frequencies of Generation 2 compare to those on the mainland in Generation 1?

After reproduction, how do the **island** phenotypic frequencies of Generation 2 compare to those on the mainland in Generation 1?

3. Gene Flow

Every so often the currents are favorable and allow some Bingo Chips to swim from the island to the mainland or vice versa.

- One member of your group will choose up to 5 intrepid Bingo Chips to move from one population to the other – some can move to the mainland, while others can move to the island.

After the migration, each Bingo Chip reproduces clonally one time.

- For each Chip on the island and the mainland, add another Chip of the same color to the same population.

Phenotypic ratios:

Generation 3	Color 1:	Color 2:	Color 3:	Color 4:
Mainland population				
Island population				

Does evolution occur if a Bingo Chip migrates from the island to the mainland, but then dies without reproducing? Why or why not?

4. Genetic Drift

You and your team have gone to get more supplies to continue your work at the field site, so several generations go by before you can make an observation of these populations.
Chose another group member to act out the effects of genetic drift.

- They will close their eyes and remove 2 Chips from the mainland population and 2 from the island population.

These unfortunate Bingo Chips have perished before they are able to reproduce. All the remaining Bingo Chips will reproduce clonally one time.

- For each Chip on the island and the mainland, add another Chip of the same color to the same population.

Again, the group member will:

- close their eyes and remove 8 Chips from the mainland population and 8 from the island population.

All the remaining Bingo Chips will reproduce clonally one time.

- For each Chip on the island and the mainland, add another Chip of the same color to the same population.

Phenotypic ratios:

Generation 5	Color 1:	Color 2:	Color 3:	Color 4:
Mainland population				
Island population				

Which color, if any, has become more prevalent in the mainland population? Which color has become more rare?

Which color, if any, has become more prevalent in the island population? Which has become more rare?

Which population looks most different from your original population at Generation 1?

5. Natural Selection

Choose another group member to act as a dreaded flying predator of the Bingo Chips. This group member will choose their two favorite colors of Chips to eat.

- Fly between the island and the mainland, removing 10 Bingo Chips of these two colors in total (decide how many to eat from each population).

All the remaining (and relieved) Bingo Chips will reproduce clonally one time.

- For each Chip on the island and the mainland, add another Chip of the same color to the same population.

Phenotypic ratios:

Generation 6	Color 1:	Color 2:	Color 3:	Color 4:
Mainland population				
Island population				

What characteristics of Bingo Chips or their environment might help one color of Bingo Chip survive better than another?

Does evolution happen if a Bingo Chip is better at surviving, but would not reproduce?

6. Population Bottleneck

Chose another group member to become a force of nature. This group member will decide what event of mass destruction they represent (hurricane? earthquake? zombies?). Bingo Chips will die in alarming numbers, but which ones will depend on the event. Will it be proximity to the ocean? Phenotypic color or disease susceptibility? Completely at random?

- Remove all but 10 Bingo Chips (decide how to split the survivors between populations).

These (extremely shaken) Bingo Chips are grateful to have survived and begin to rebuild their lives. They undergo one last repopulation event.

- For each Chip on the island and the mainland, add another Chip of the same color to the same population.

Phenotypic ratios:

Generation 7	Color 1:	Color 2:	Color 3:	Color 4:
Mainland population				
Island population				

Have any colors disappeared in Generation 7, in either population? Will there be any Bingo Chips of this color in future generations?

Now that you have completed your field season, describe what happened to each color of Bingo Chip over the seven generations you've observed.