

# ASSIGNMENT 10: THE WRIGHT-FISHER MODEL

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Bio5488  
Spring 2016

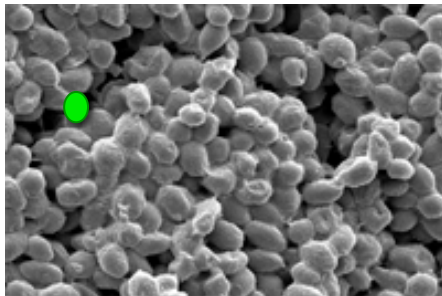
Happy April Fool's Day.  
Everyone gets a 0 on this homework.  
(Disclaimer: THIS IS A JOKE)

# Story time!

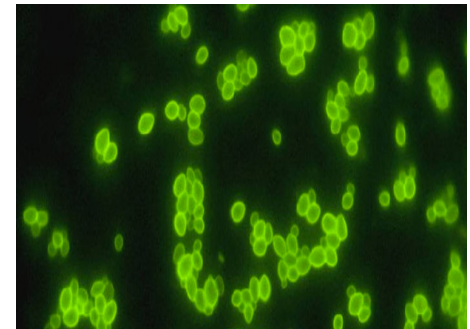
- You have cloned a gene from a Martian yeast strain with a mutation that you believe dramatically increases fitness.



- You decide to call this allele Bio5488. You insert Bio5488 into a chromosome of a lab strain.
- When you take one cell of the Bio5488 lab strain and place it in a culture of 99 wild-type cells, the Bio5488 allele fixes 90% of the time after 1000 generations.



1000 generations after...

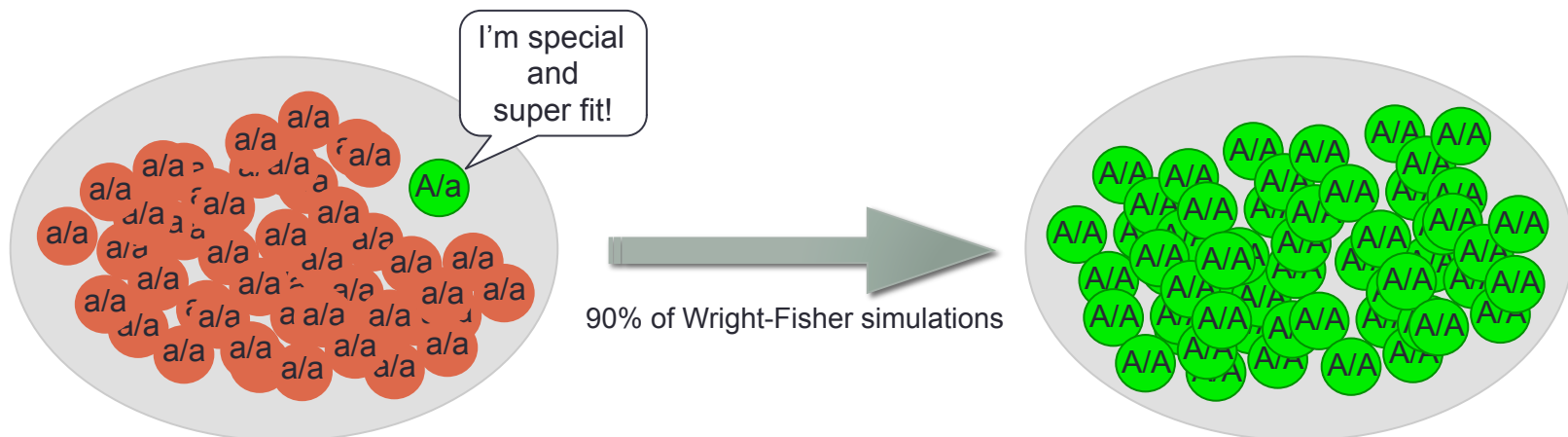


- Being an expert in population genetics (because of your 1st year genomics class), you decide to estimate the approximate fitness of the Bio5488 allele.

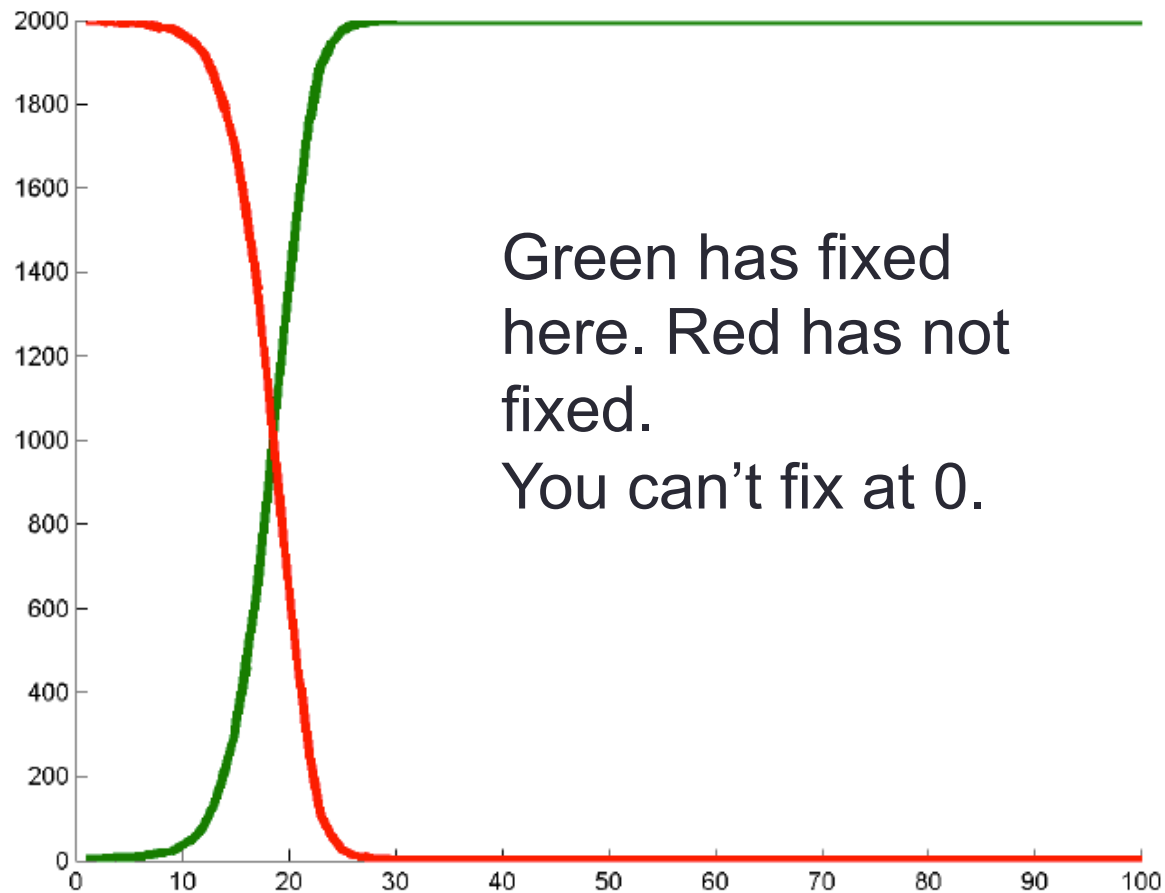
# The Wright-Fisher Model

**Goal:** Determine what fitness level is required to make your allele (Gene<sup>Bio5488</sup>) become fixed in a population 90% of the time.

**STEP I:** Initialize a population where each individual gets 2 alleles. In our case, we'll start with everyone homozygous for the non-Bio5488 allele except one individual is heterozygous.



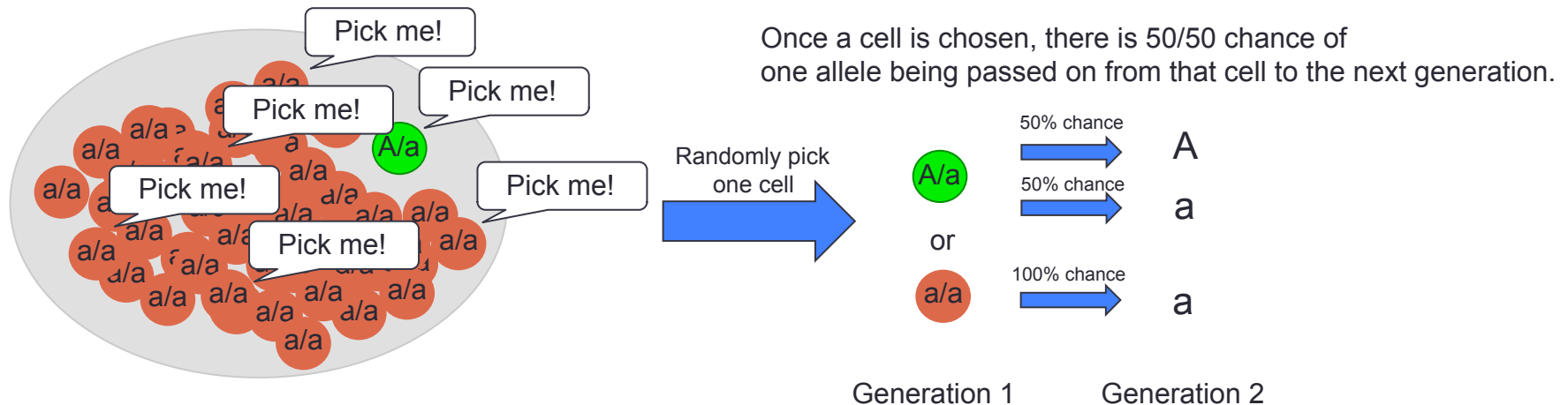
Fixation = homozygous for that allele in the entire population



# Random mating process

**STEP II:** Randomly pick individuals from the population based on their fitness values. So if the fitness for individual A is 3 and individual B is 1, then it should be 3 times more likely to pick A. Once you pick individual A, you need to pick only one of its alleles. Then pick the first individual in the next generation's second allele separately.

**Note:** We use perfect sampling with replacement model!!



*Hint:* Assign a number (1-100) for each yeast cell and use random number generator to randomly pick a cell. Don't forget to account for fitness when choosing a cell!!

# Is it dead yet?

**STEP III:** Check for fixation of either allele by the maximum generation. *If no fixation*, make another generation. If there is fixation, record which allele fixed. Then start over with the original starting population.

**STEP IV:** Repeat steps I-III 100 times and give the percent of the time that the Bio5488 allele fixed.

# Overview of assignment parts

- **Part 1: Bio5488 as a dominant allele**
  - Complete dominance. No non-Mendelian real-world messy genetics to complicate this.
  - Heterozygotes get the same fitness advantage as homozygous dominant for Bio5488
- **Part 2: Bio5488 as a recessive allele**
  - Totally recessive. Bio5488 is a ninja.
  - Heterozygotes have no fitness advantage.
- **Part 3: Plot fixation for dominant and recessive simulations.**
  - Plan ahead in your coding!

# Part 3 plots

## Informative title

FREQUENCY

?

- AA freq
- Aa/aA freq
- Aa freq
- A freq
- A freq

GENERATION



# In and out

## **Parameters into wrightfisher.py:**

- Population size
- Maximum number of generations
- Fitness score
- Model (dominant or recessive)

## **TURN IN**

- README.txt
- wrightfisher.py
- allelic\_frequency\_vs\_generations\_dominant.png
- allelic\_frequency\_vs\_generations\_recessive.png