

Mutations

Evolution & Ecology

Jacopo Grilli, Ciudad de Guatemala, 26/11/2025

Plan

L1 - Exponential growth

L2 - Mutations

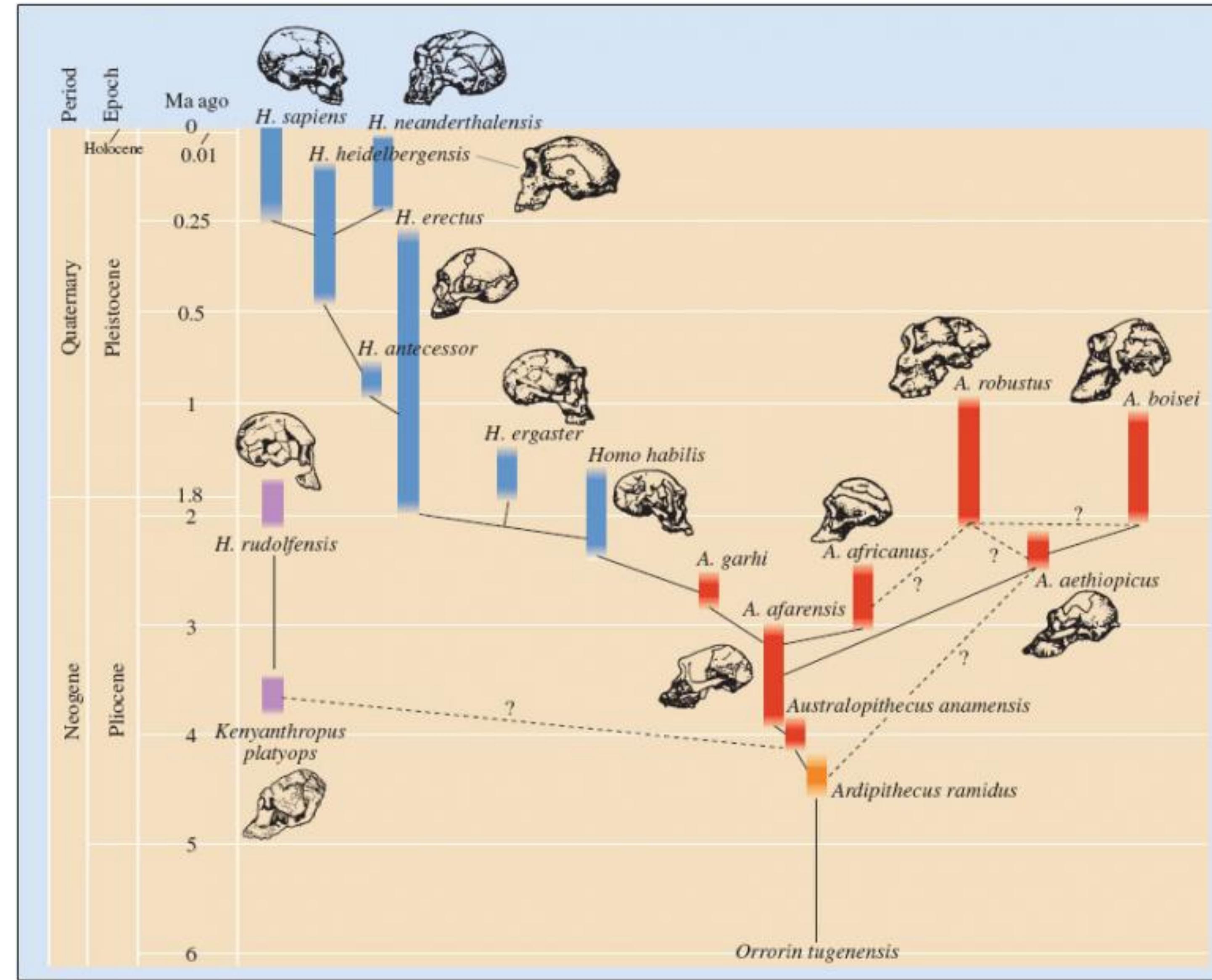
L3 - Selection

L4 - Ecology

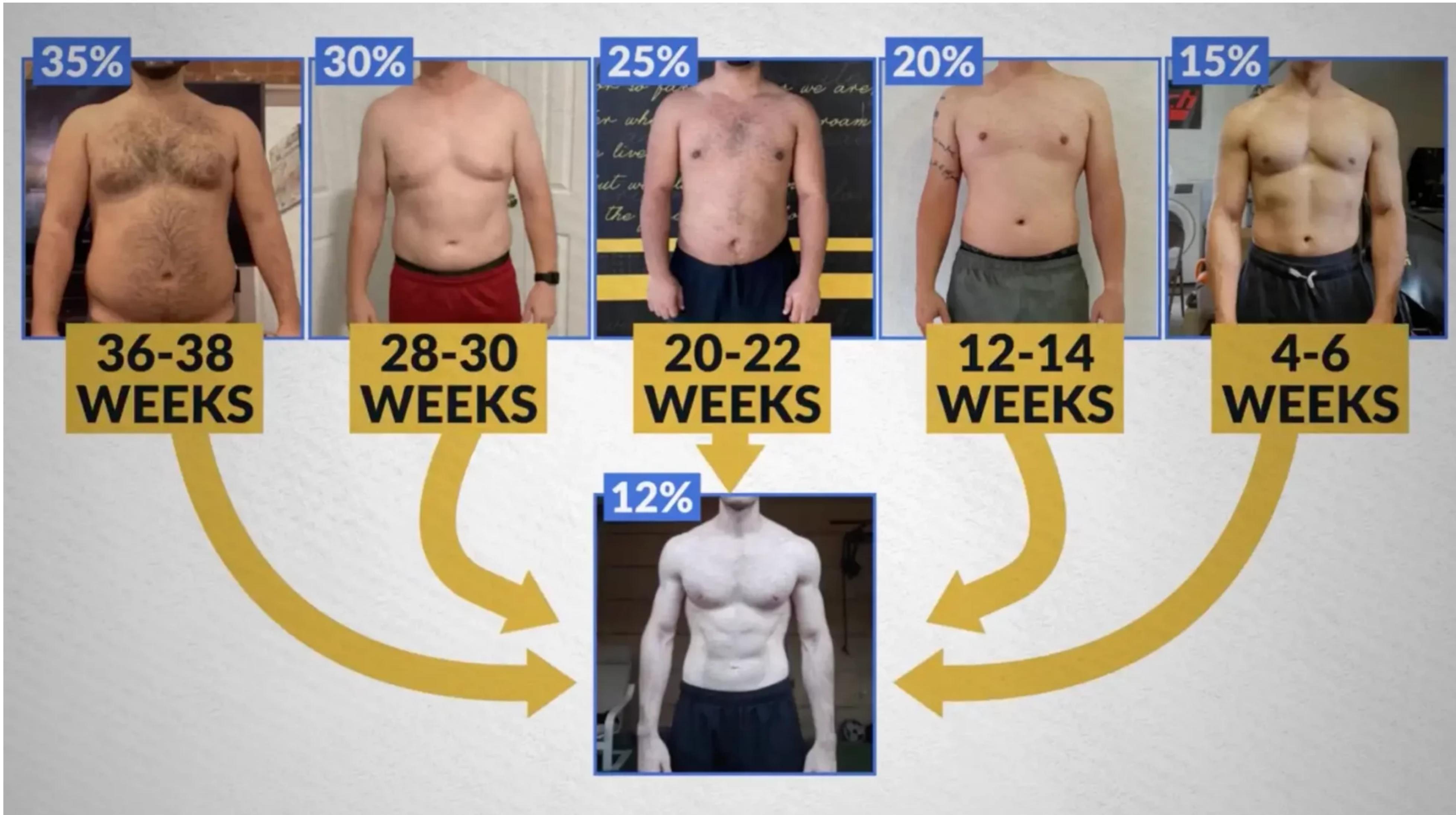
L5 - Eco-Evo

What is Evolution?

Evolution is about variation and change



What type of change?



Evolution is about heritable variation

heritable = passed from parent(s) to offsprings

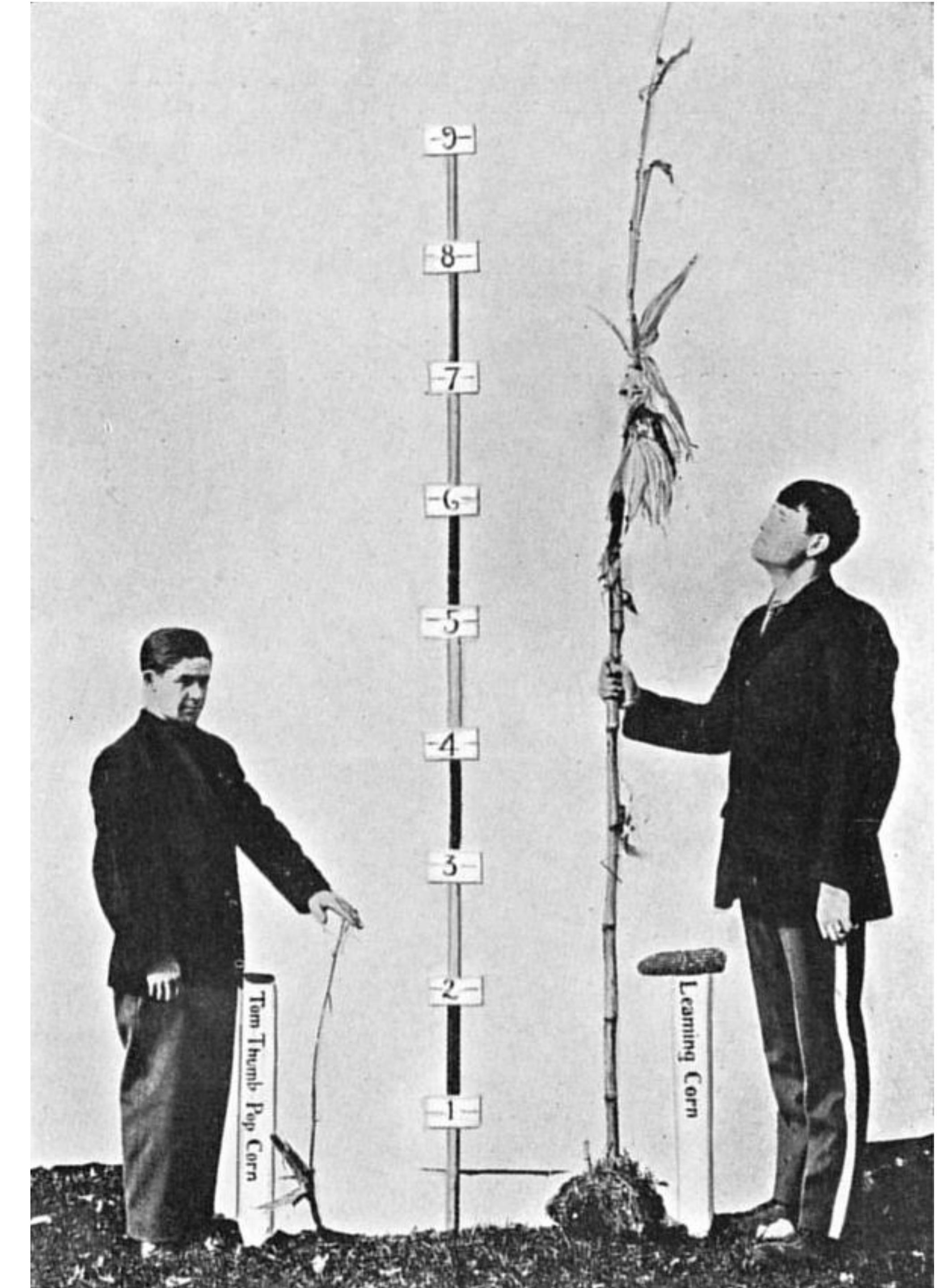
A man with glasses and a dark shirt is pointing at a presentation slide on a screen. The slide is titled "Statistics Characterizing observed randomness" and features a portrait of Sir Francis Galton (1822-1911). It includes sections on "Case of study: Human height heritage", "Summary statistics", "Data", "Correlations", and "Midparent height".

Case of study: Human height heritage

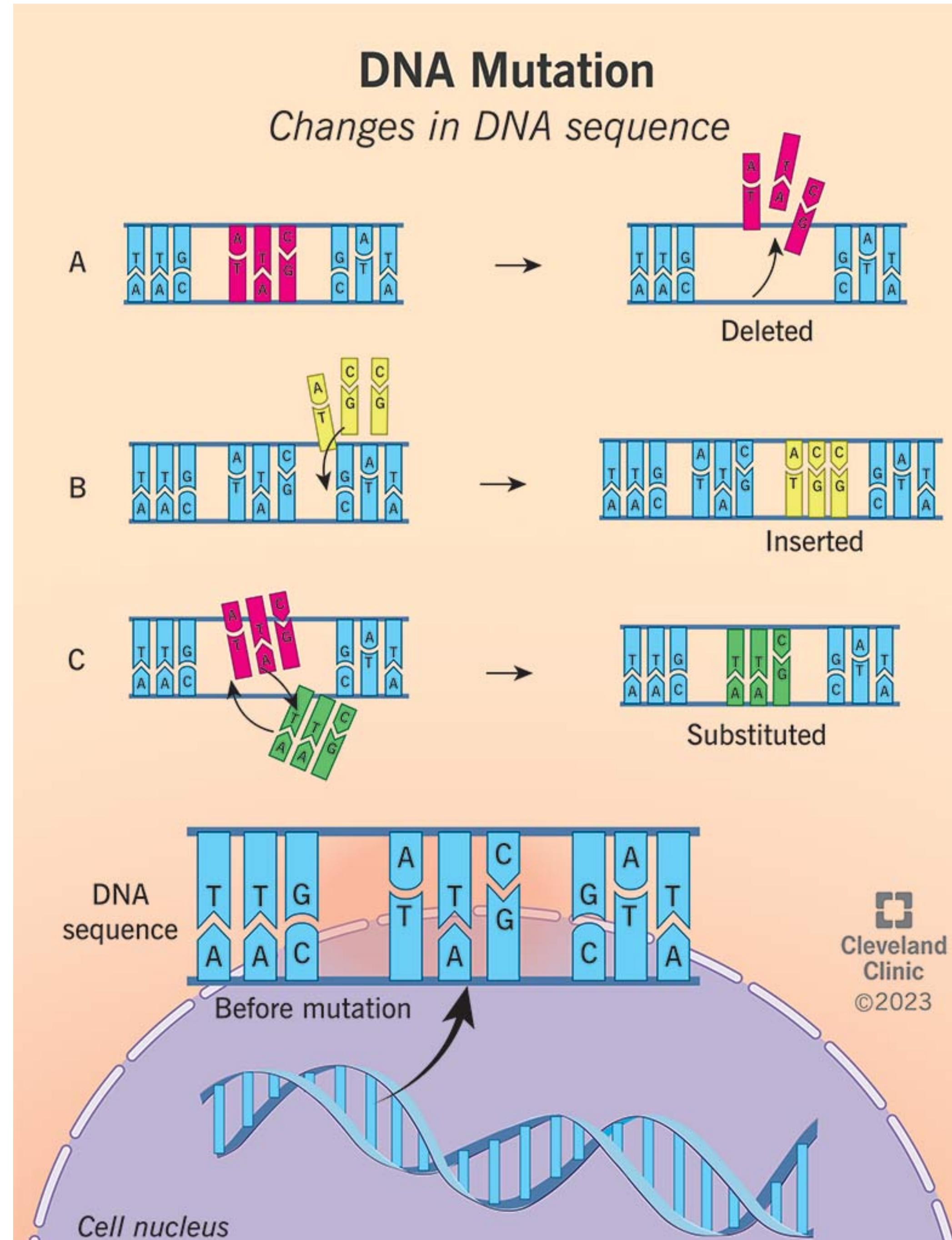
Summary statistics

Data

Family	Father height	Mother height	Sister height	Brother height	Son height	Daughter height
0	68.5	67.0	67.0	72.0	71.0	69.0
1	68.5	67.0	67.0	72.0	71.0	69.0
2	68.5	67.0	67.0	72.0	71.0	69.0
3	68.5	67.0	67.0	72.0	71.0	69.0
4	68.5	67.0	67.0	72.0	71.0	69.0
5	68.5	67.0	67.0	72.0	71.0	69.0
6	68.5	67.0	67.0	72.0	71.0	69.0
7	68.5	67.0	67.0	72.0	71.0	69.0
8	68.5	67.0	67.0	72.0	71.0	69.0
9	68.5	67.0	67.0	72.0	71.0	69.0
10	68.5	67.0	67.0	72.0	71.0	69.0
11	68.5	67.0	67.0	72.0	71.0	69.0
12	68.5	67.0	67.0	72.0	71.0	69.0
13	68.5	67.0	67.0	72.0	71.0	69.0
14	68.5	67.0	67.0	72.0	71.0	69.0
15	68.5	67.0	67.0	72.0	71.0	69.0
16	68.5	67.0	67.0	72.0	71.0	69.0
17	68.5	67.0	67.0	72.0	71.0	69.0
18	68.5	67.0	67.0	72.0	71.0	69.0
19	68.5	67.0	67.0	72.0	71.0	69.0
20	68.5	67.0	67.0	72.0	71.0	69.0
21	68.5	67.0	67.0	72.0	71.0	69.0
22	68.5	67.0	67.0	72.0	71.0	69.0
23	68.5	67.0	67.0	72.0	71.0	69.0
24	68.5	67.0	67.0	72.0	71.0	69.0
25	68.5	67.0	67.0	72.0	71.0	69.0
26	68.5	67.0	67.0	72.0	71.0	69.0
27	68.5	67.0	67.0	72.0	71.0	69.0
28	68.5	67.0	67.0	72.0	71.0	69.0
29	68.5	67.0	67.0	72.0	71.0	69.0
30	68.5	67.0	67.0	72.0	71.0	69.0
31	68.5	67.0	67.0	72.0	71.0	69.0
32	68.5	67.0	67.0	72.0	71.0	69.0
33	68.5	67.0	67.0	72.0	71.0	69.0
34	68.5	67.0	67.0	72.0	71.0	69.0
35	68.5	67.0	67.0	72.0	71.0	69.0
36	68.5	67.0	67.0	72.0	71.0	69.0
37	68.5	67.0	67.0	72.0	71.0	69.0
38	68.5	67.0	67.0	72.0	71.0	69.0
39	68.5	67.0	67.0	72.0	71.0	69.0
40	68.5	67.0	67.0	72.0	71.0	69.0
41	68.5	67.0	67.0	72.0	71.0	69.0
42	68.5	67.0	67.0	72.0	71.0	69.0
43	68.5	67.0	67.0	72.0	71.0	69.0
44	68.5	67.0	67.0	72.0	71.0	69.0
45	68.5	67.0	67.0	72.0	71.0	69.0
46	68.5	67.0	67.0	72.0	71.0	69.0
47	68.5	67.0	67.0	72.0	71.0	69.0
48	68.5	67.0	67.0	72.0	71.0	69.0
49	68.5	67.0	67.0	72.0	71.0	69.0
50	68.5	67.0	67.0	72.0	71.0	69.0
51	68.5	67.0	67.0	72.0	71.0	69.0
52	68.5	67.0	67.0	72.0	71.0	69.0
53	68.5	67.0	67.0	72.0	71.0	69.0
54	68.5	67.0	67.0	72.0	71.0	69.0
55	68.5	67.0	67.0	72.0	71.0	69.0
56	68.5	67.0	67.0	72.0	71.0	69.0
57	68.5	67.0	67.0	72.0	71.0	69.0
58	68.5	67.0	67.0	72.0	71.0	69.0
59	68.5	67.0	67.0	72.0	71.0	69.0
60	68.5	67.0	67.0	72.0	71.0	69.0
61	68.5	67.0	67.0	72.0	71.0	69.0
62	68.5	67.0	67.0	72.0	71.0	69.0
63	68.5	67.0	67.0	72.0	71.0	69.0
64	68.5	67.0	67.0	72.0	71.0	69.0
65	68.5	67.0	67.0	72.0	71.0	69.0
66	68.5	67.0	67.0	72.0	71.0	69.0
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70	68.5	67.0	67.0	72.0	71.0	69.0
71	68.5	67.0	67.0	72.0	71.0	69.0
72	68.5	67.0	67.0	72.0	71.0	69.0
73	68.5	67.0	67.0	72.0	71.0	69.0
74	68.5	67.0	67.0	72.0	71.0	69.0
75	68.5	67.0	67.0	72.0	71.0	69.0
76	68.5	67.0	67.0	72.0	71.0	69.0
77	68.5	67.0	67.0	72.0	71.0	69.0
78	68.5	67.0	67.0	72.0	71.0	69.0
79	68.5	67.0	67.0	72.0	71.0	69.0
80	68.5	67.0	67.0	72.0	71.0	69.0
81	68.5	67.0	67.0	72.0	71.0	69.0
82	68.5	67.0	67.0	72.0	71.0	69.0
83	68.5	67.0	67.0	72.0	71.0	69.0
84	68.5	67.0	67.0	72.0	71.0	69.0
85	68.5	67.0	67.0	72.0	71.0	69.0
86	68.5	67.0	67.0	72.0	71.0	69.0
87	68.5	67.0	67.0	72.0	71.0	69.0
88	68.5	67.0	67.0	72.0	71.0	69.0
89	68.5	67.0	67.0	72.0	71.0	69.0
90	68.5	67.0	67.0	72.0	71.0	69.0
91	68.5	67.0	67.0	72.0	71.0	69.0
92	68.5	67.0	67.0	72.0	71.0	69.0
93	68.5	67.0	67.0	72.0	71.0	69.0
94	68.5	67.0	67.0	72.0	71.0	69.0
95	68.5	67.0	67.0	72.0	71.0	69.0
96	68.5	67.0	67.0	72.0	71.0	69.0
97	68.5	67.0	67.0	72.0	71.0	69.0
98	68.5	67.0	67.0	72.0	71.0	69.0
99	68.5	67.0	67.0	72.0	71.0	69.0
100	68.5	67.0	67.0	72.0	71.0	69.0



Mutations is one source of heritable variation



Selection acts on the existing variation

some heritable traits make some individuals more likely to reproduce than others

One outcome of selection is adaptation



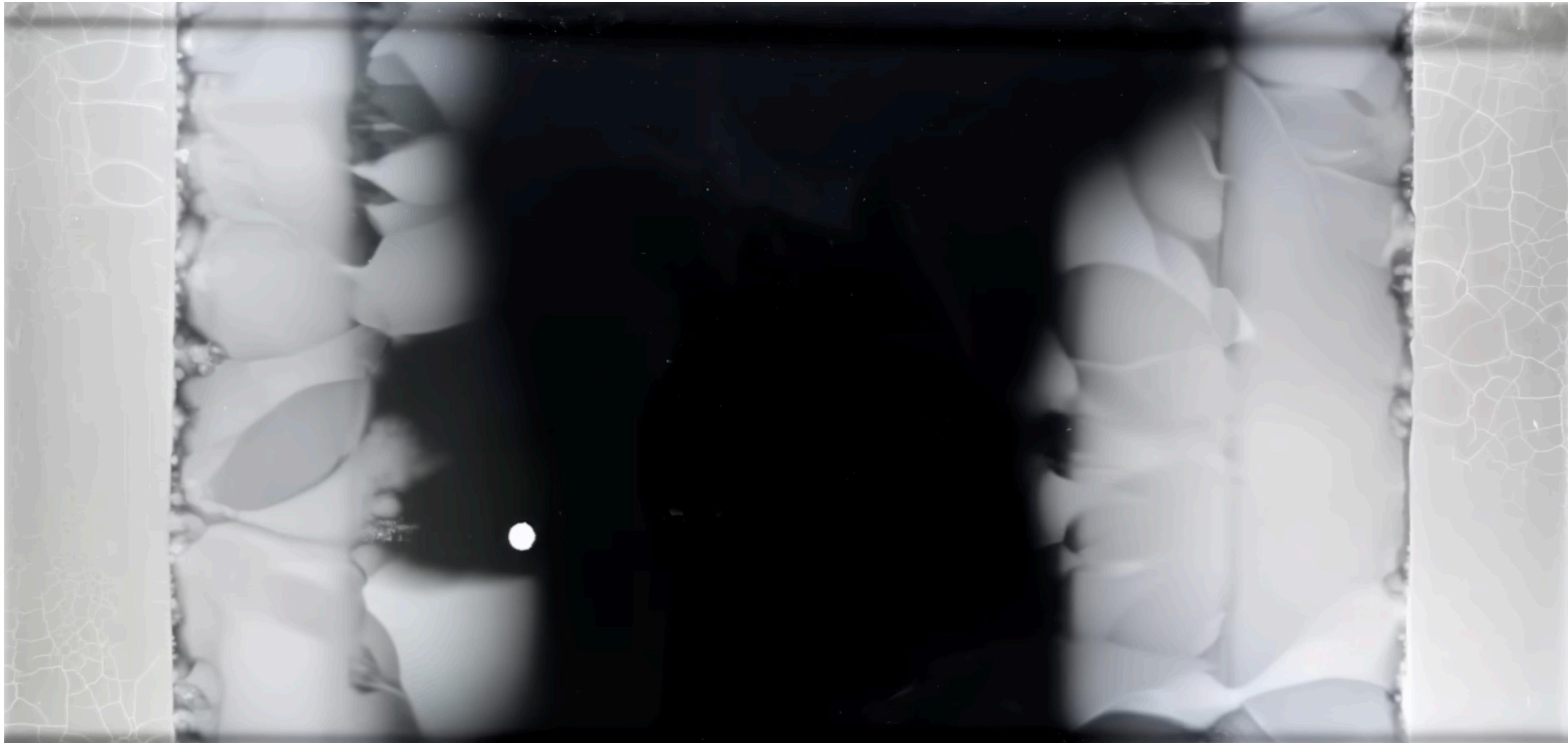
One outcome of selection is adaptation



Evolution in action

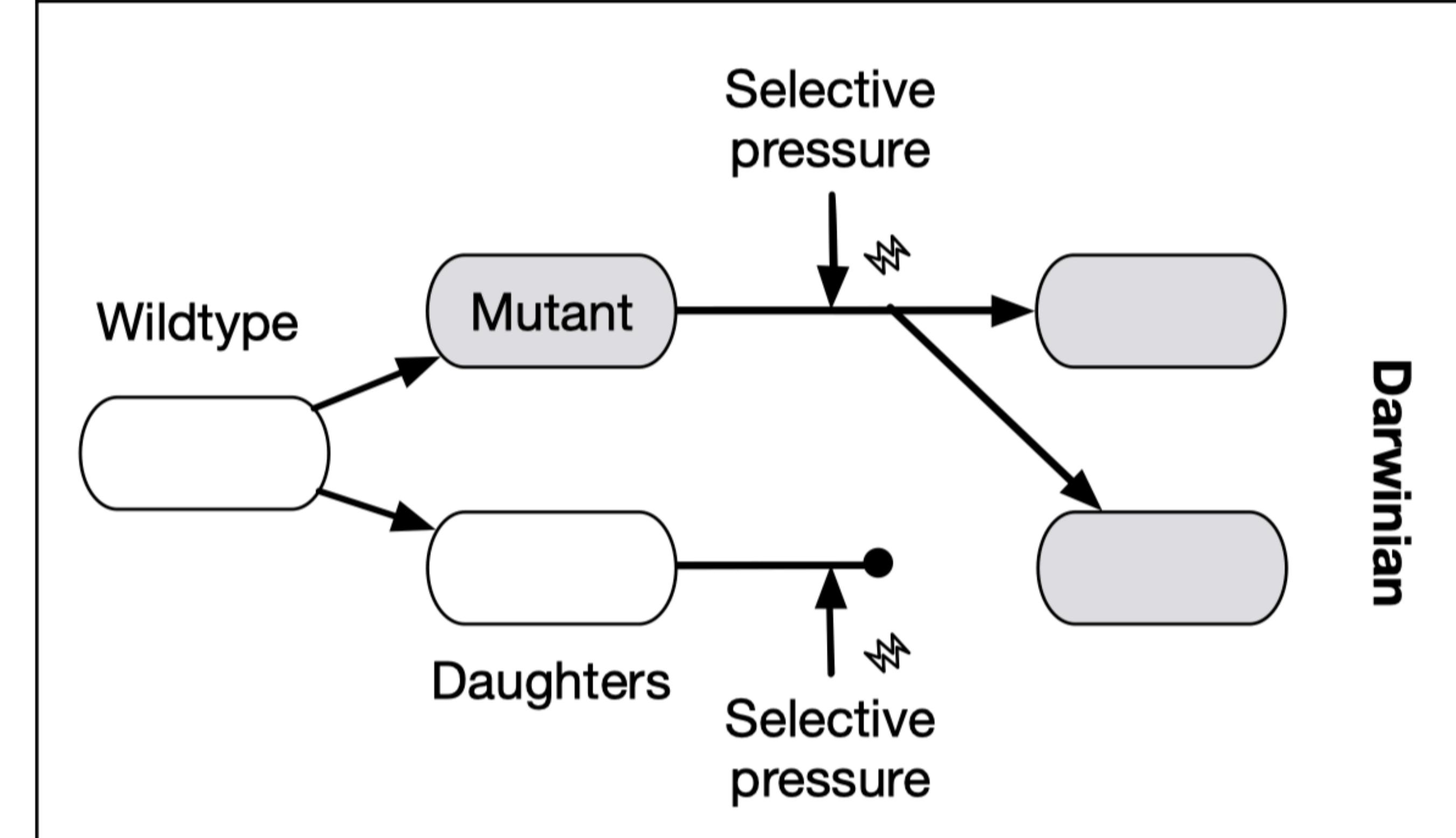
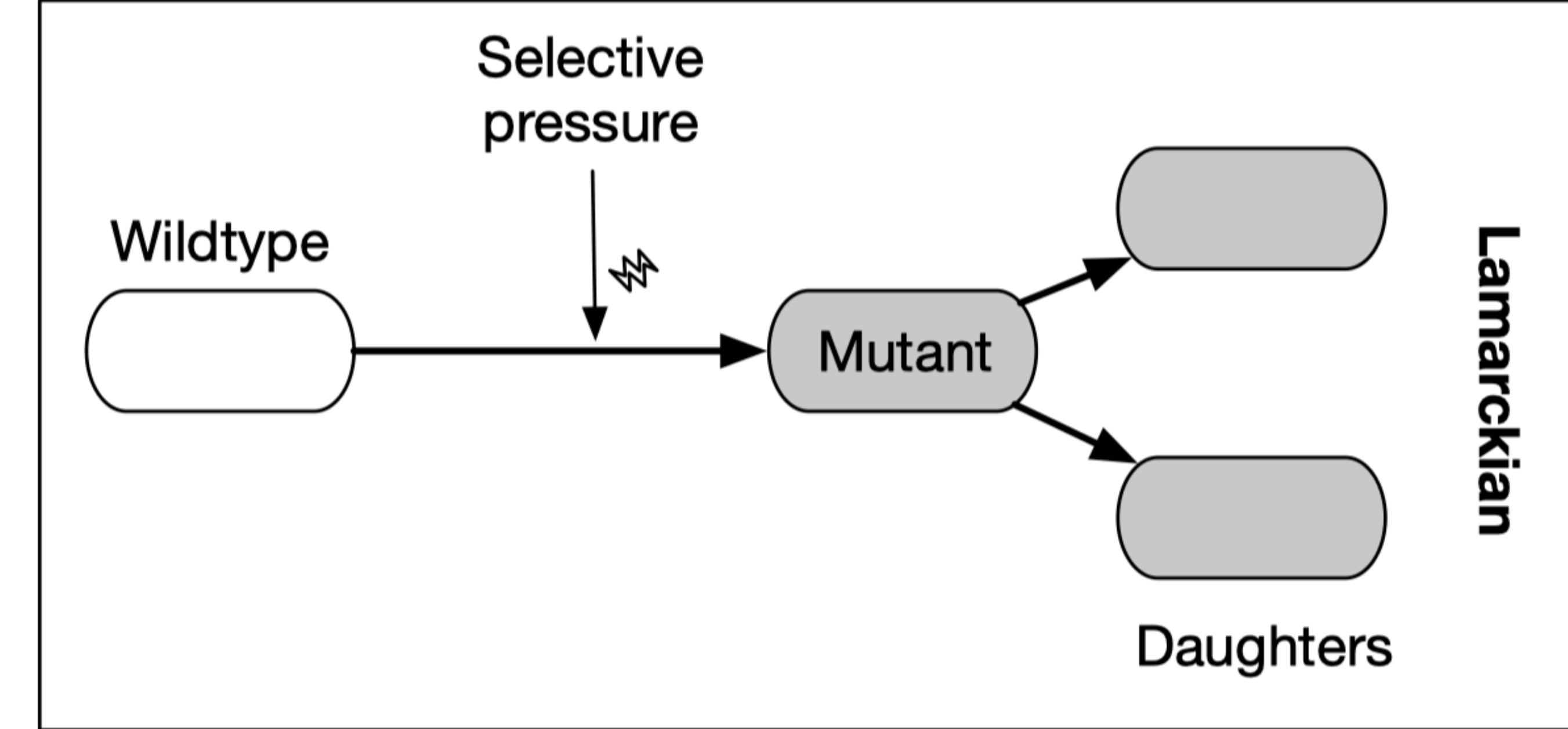


How do we know that this is about mutations?



It could be a response to a challenge

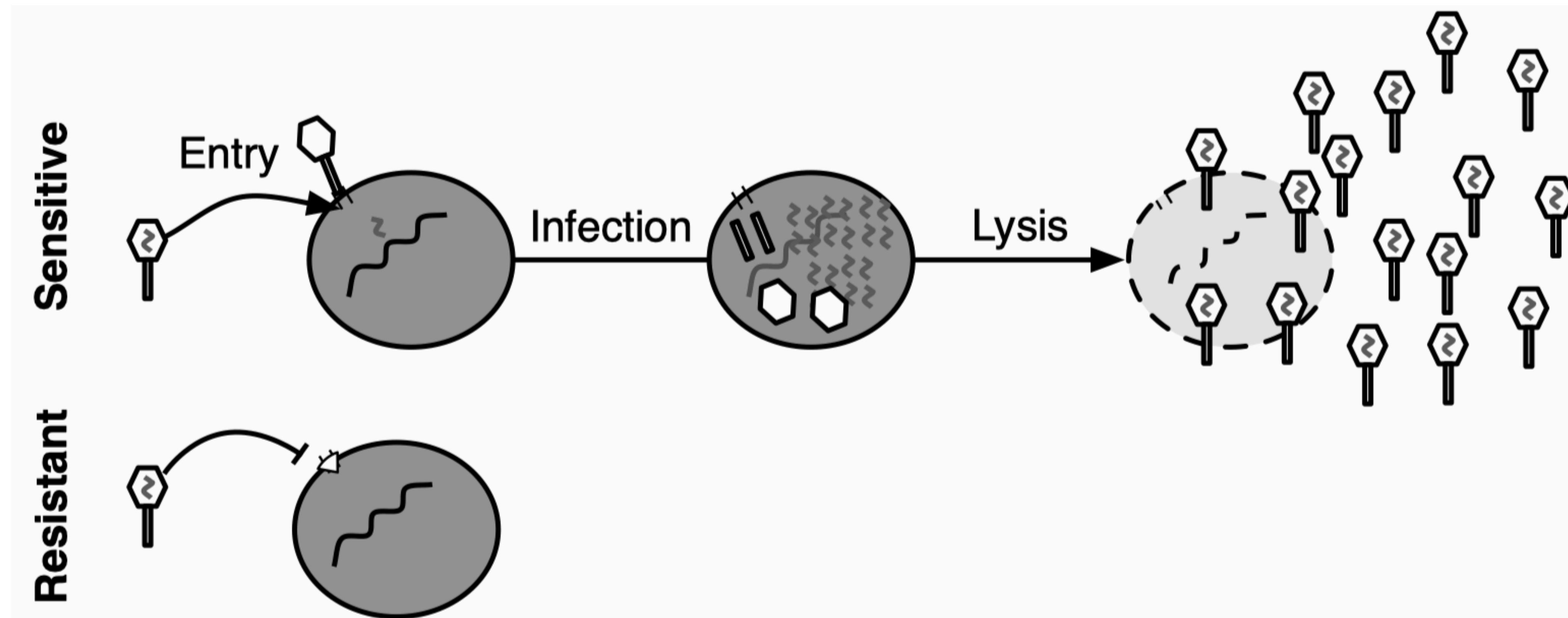
Two views of evolution



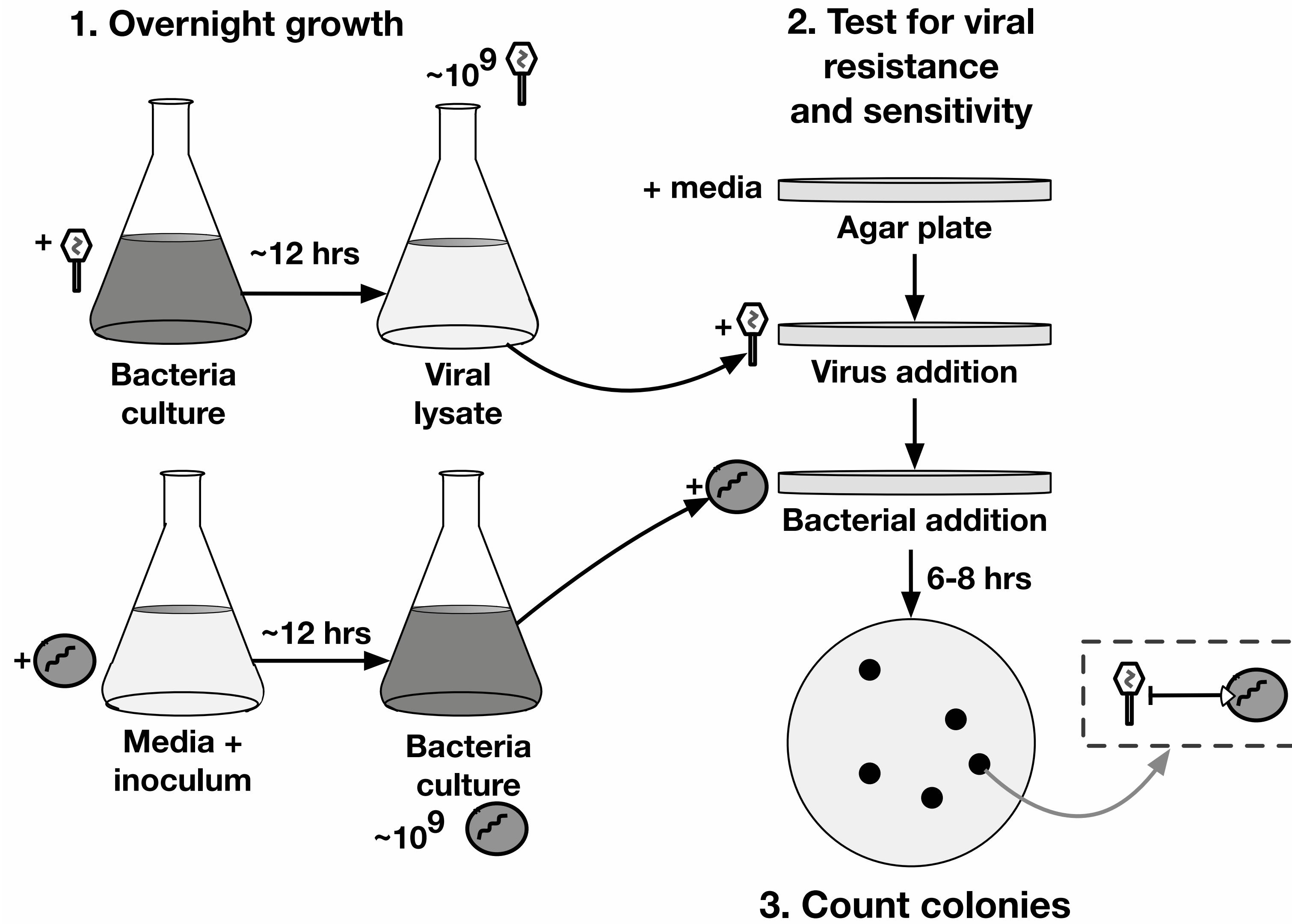
Luria and Delbrück



One slide about bacteria and phages



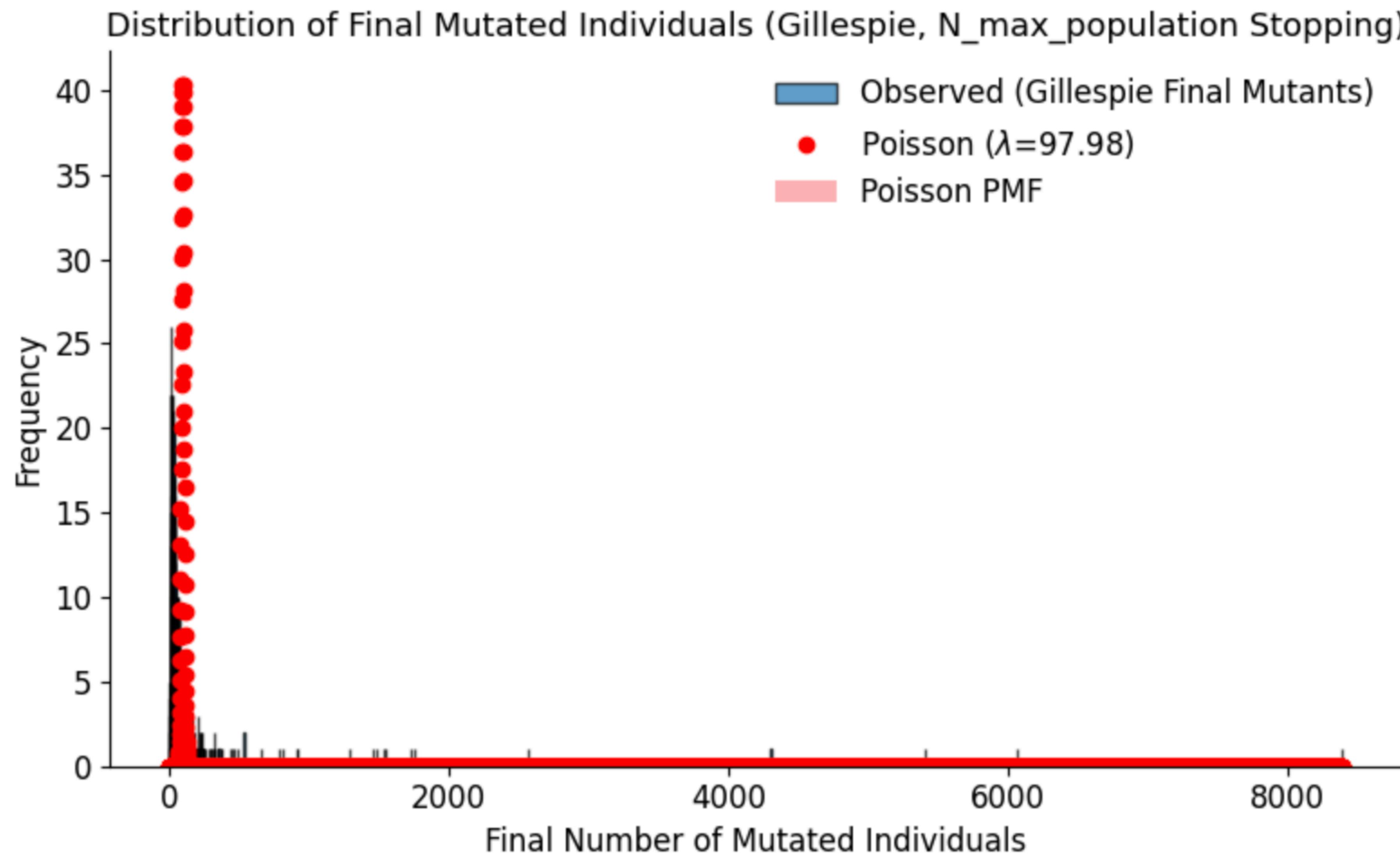
Luria-Delbrück experiment



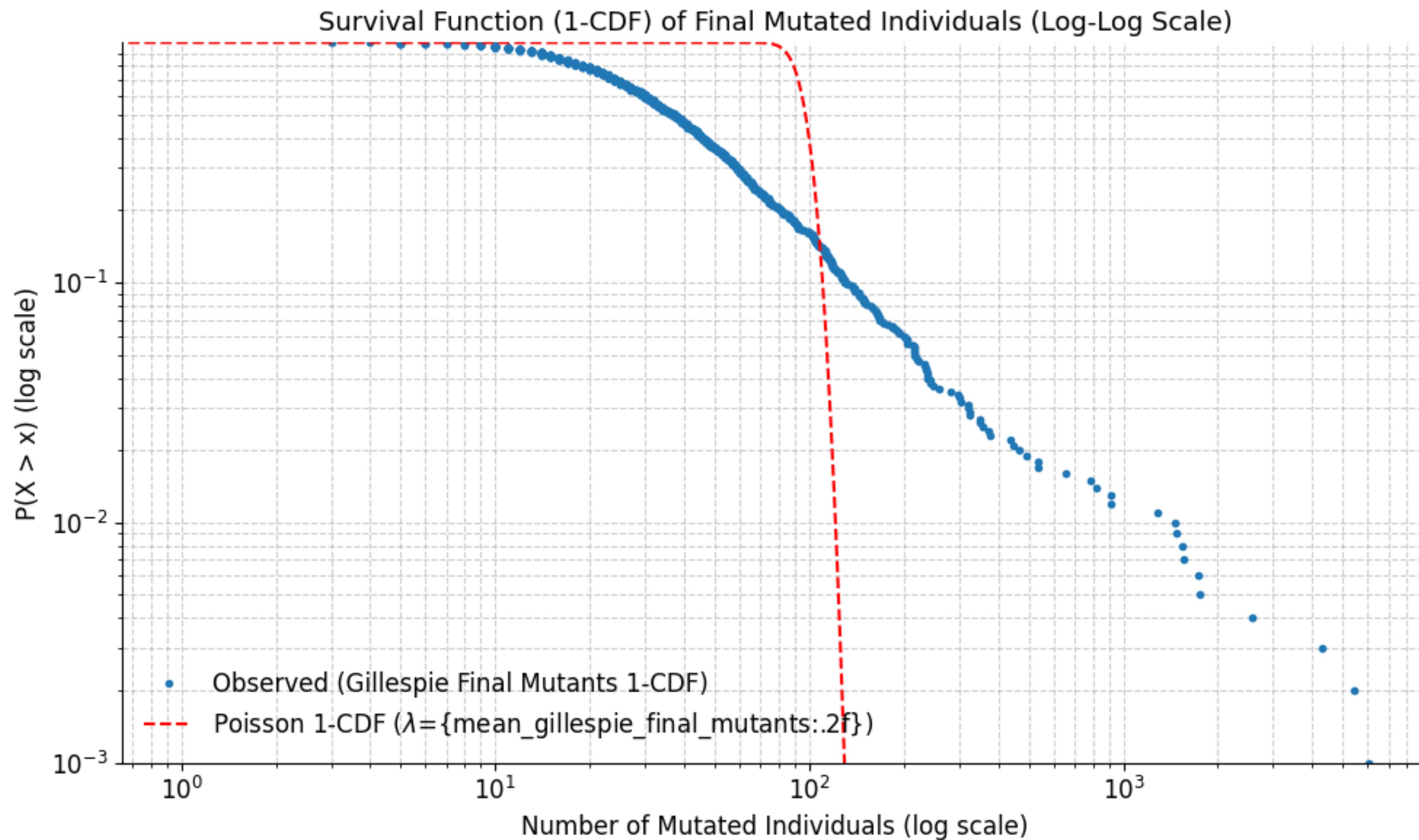
How many colonies should you expect?

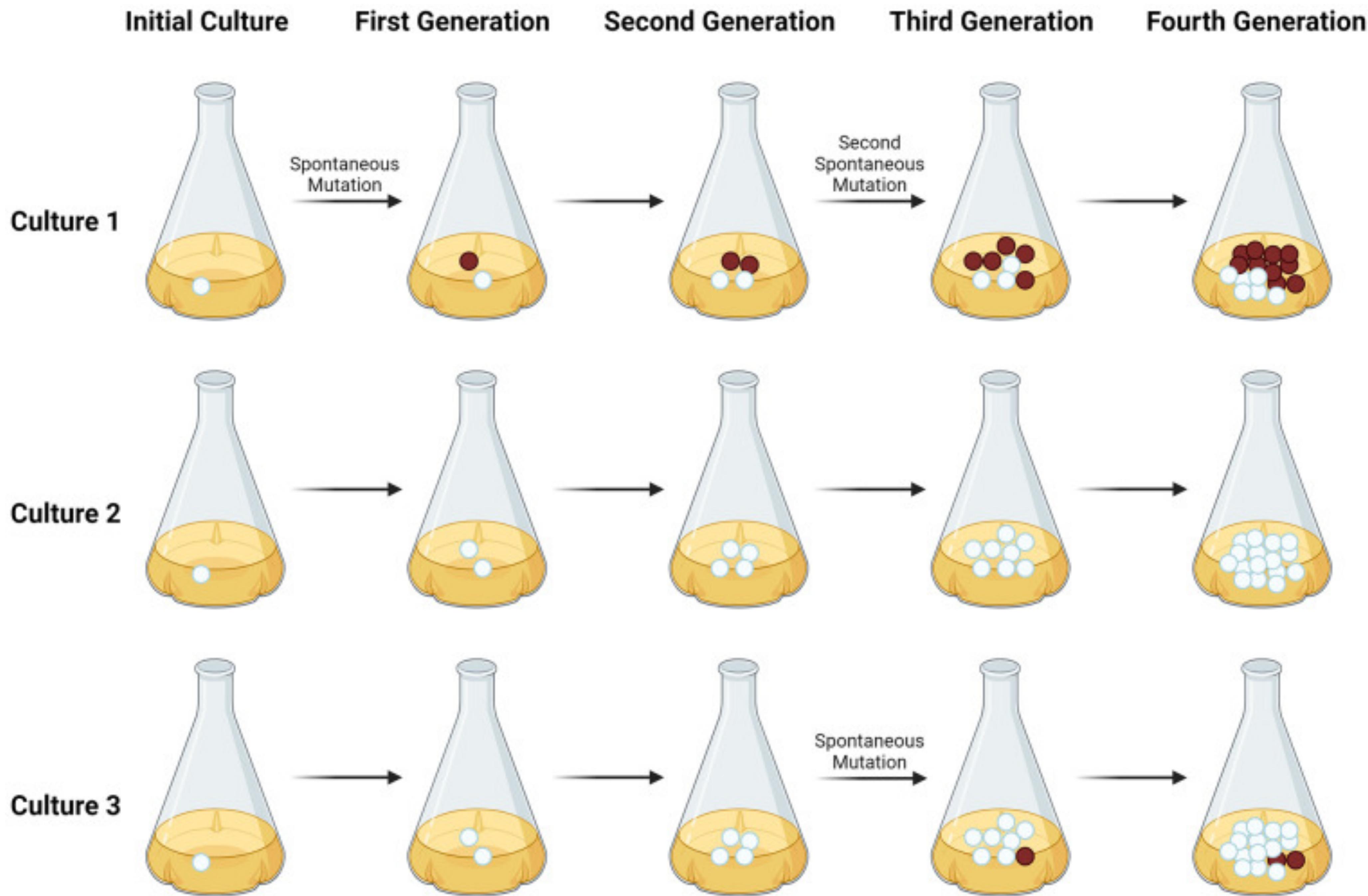
let's count!

Simulation Results



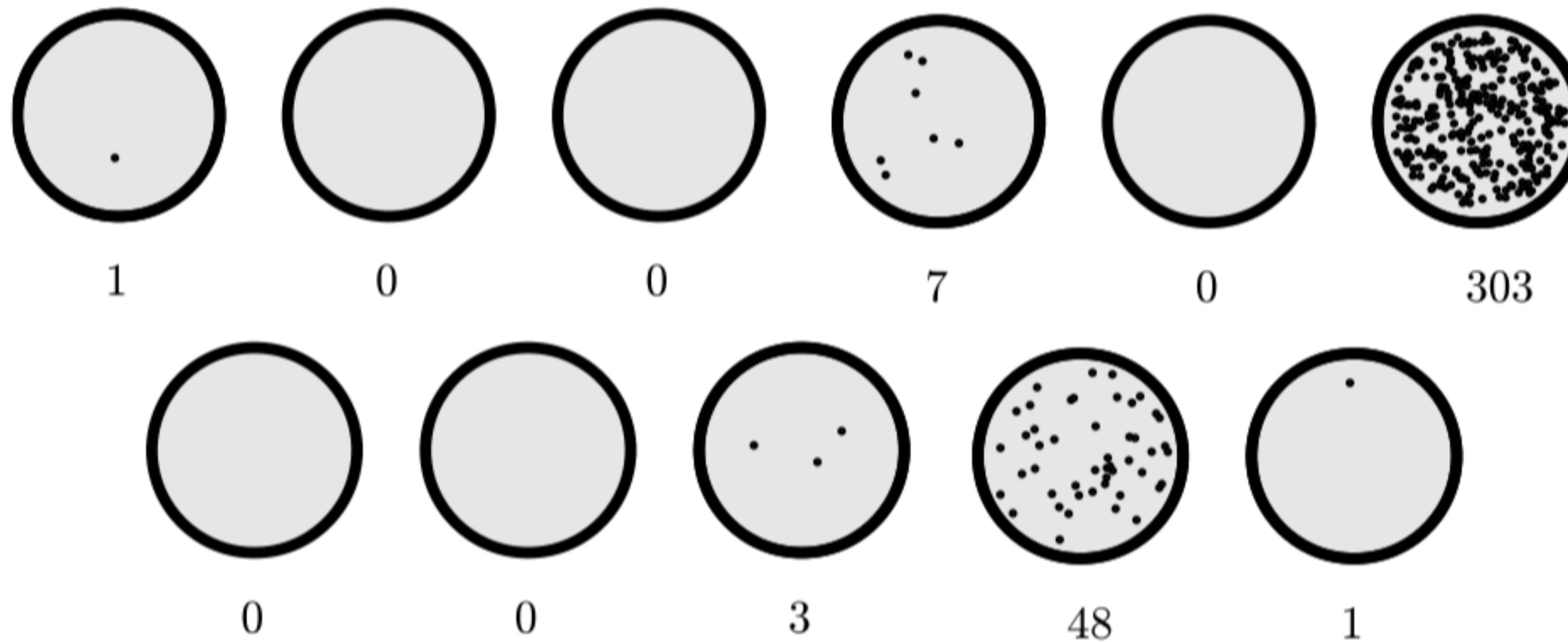
Simulation Results





How many colonies should you expect?

What is the variability of the number of colonies?



The original experimental data

A modern view

