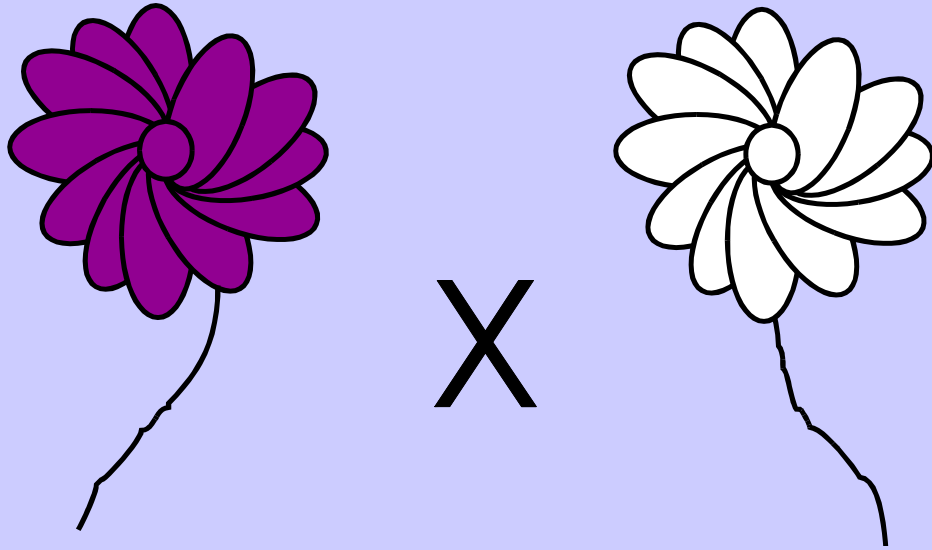
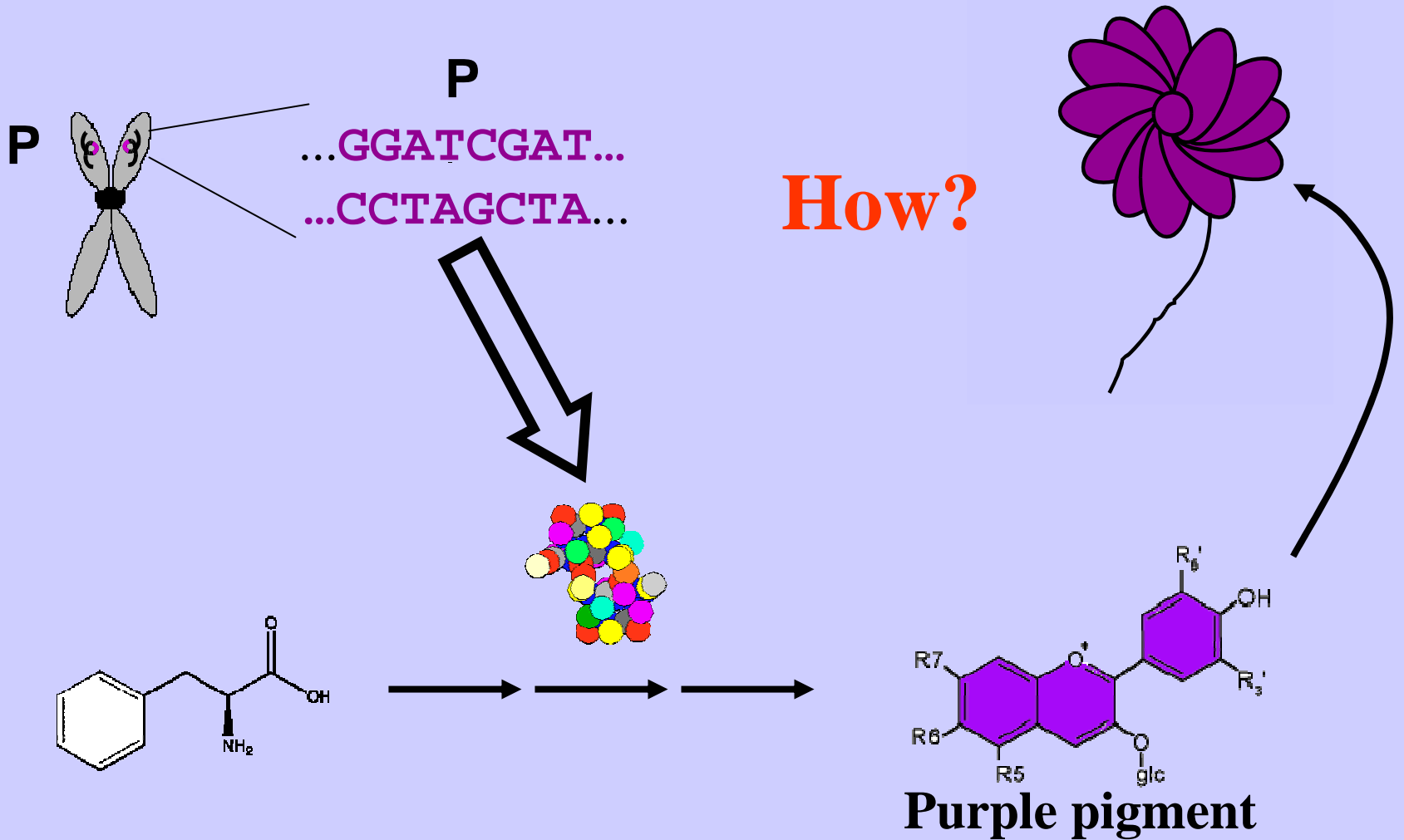


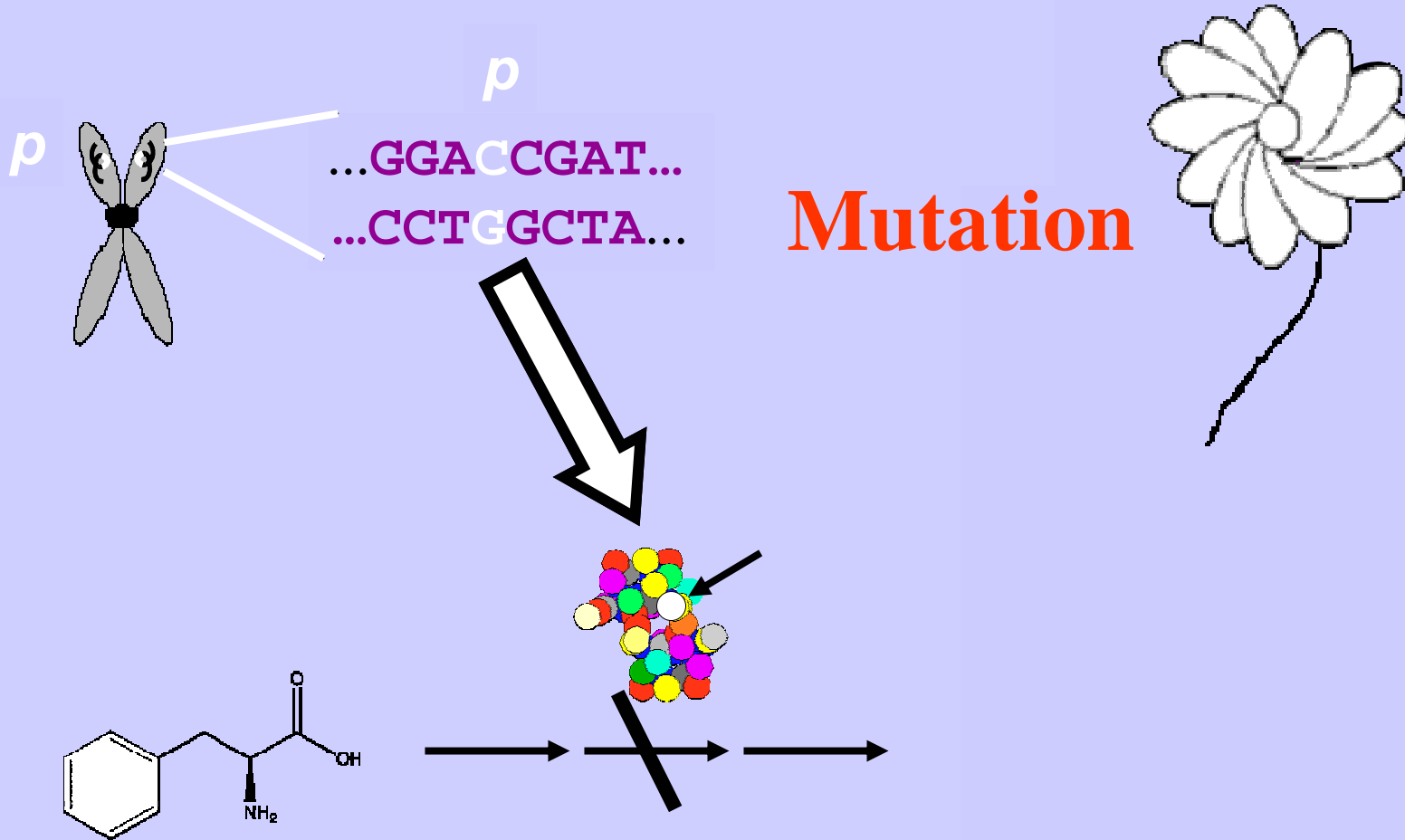
How close is close enough?



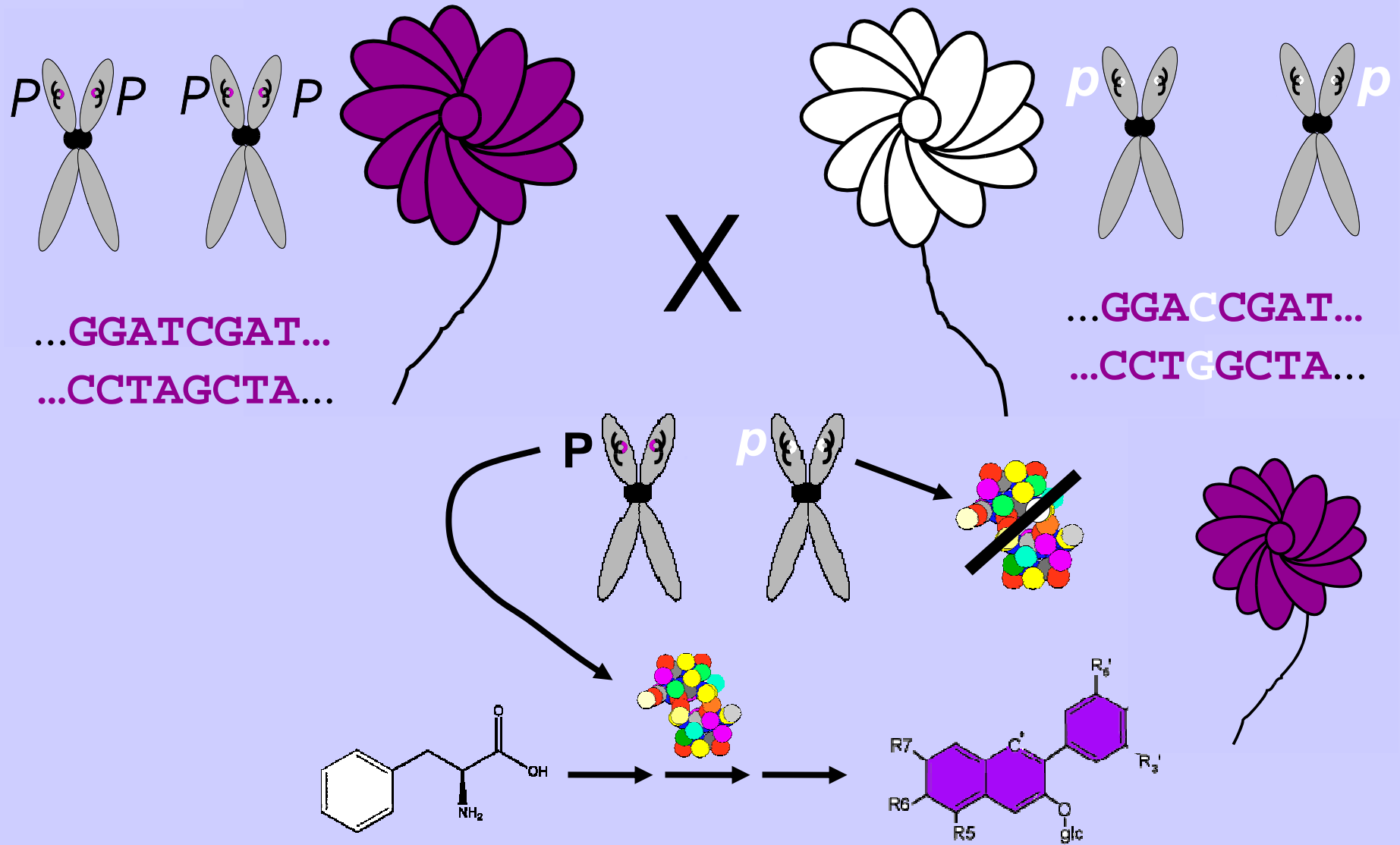
Mendel's Monohybrid Cross



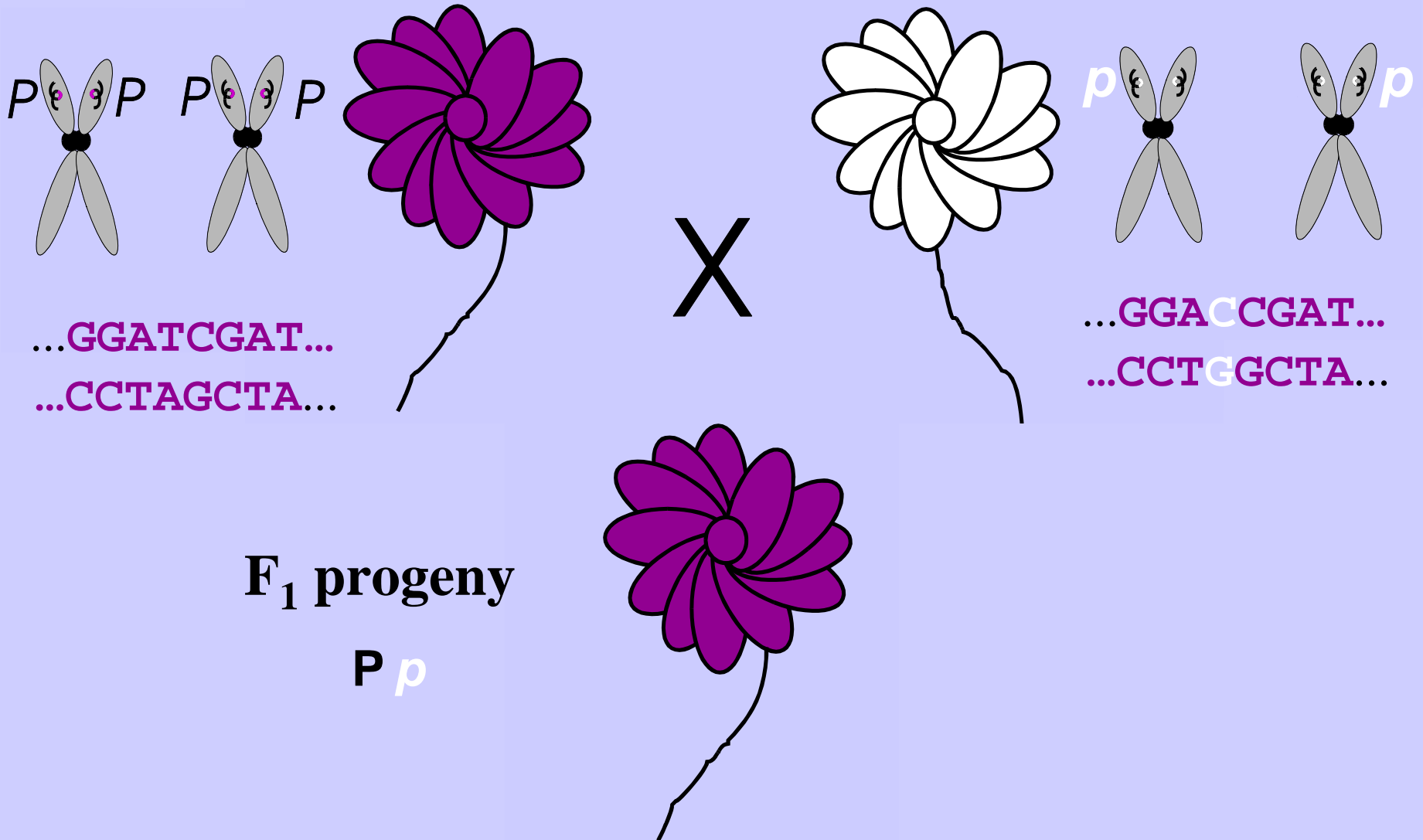
Mendel's Monohybrid Cross



Mendel's Monohybrid Cross

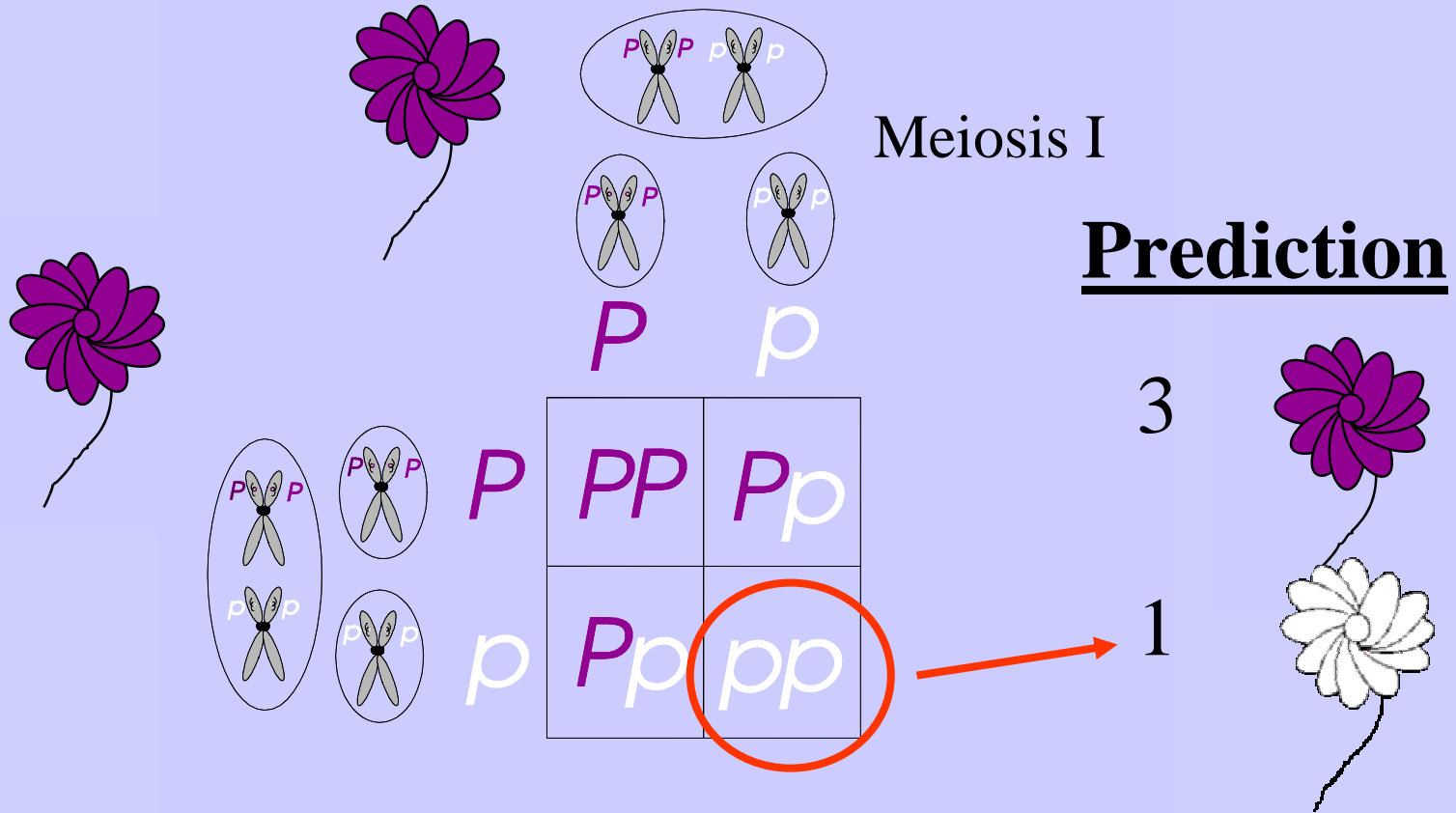


Mendel's Monohybrid Cross



Mendel's Monohybrid Cross

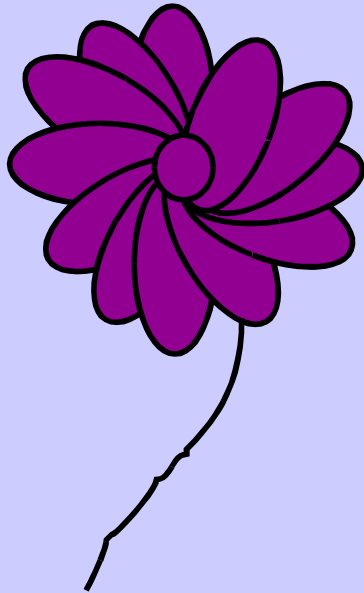
F₁ Cross



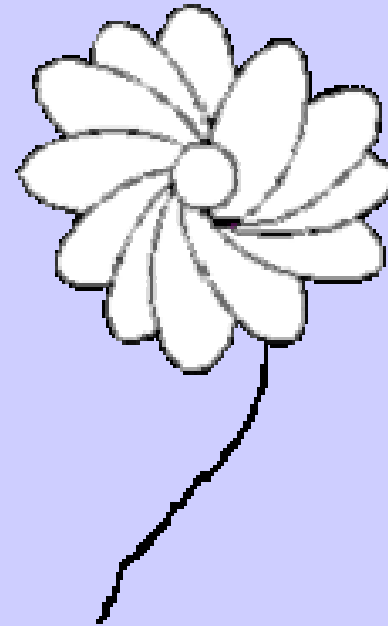
Mendel's Monohybrid Cross

F₁ Cross - Results

705



224



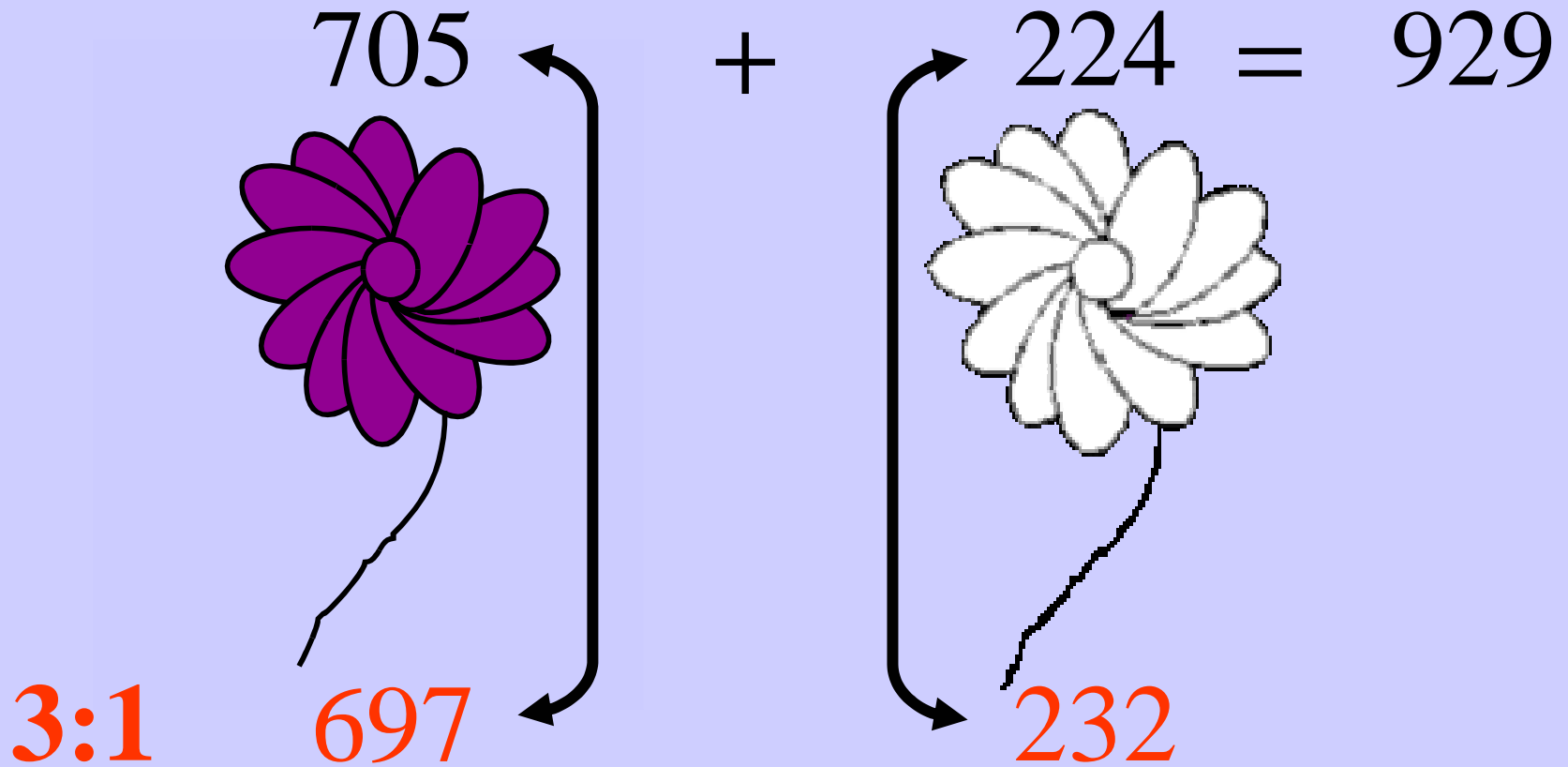
Mendel's actual results



*Thank you for
your kind
attention*

Was Mendel Right?

F₁ Cross - Results





*Thank you for
your kind
attention*

Was Mendel Right?

F₁ Cross - Results

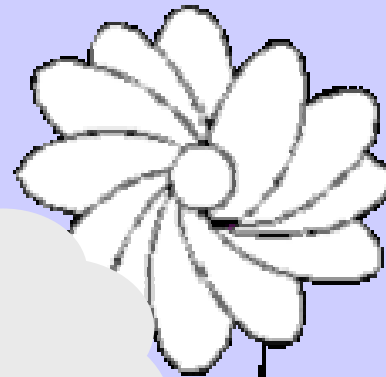
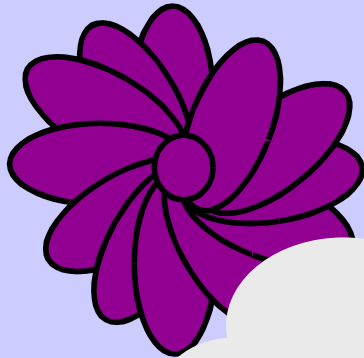
705

+

224

=

929



χ^2

analysis

3:1

697

232

Was Mendel Right?

χ^2 Analysis

$$\begin{aligned}\chi^2 &= \sum \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}} \\ &= \frac{(705 - 697)^2}{697} + \frac{(224 - 232)^2}{232} \\ &= 0.368\end{aligned}$$

	p value											
df	0.25	0.20	0.15	0.10	0.05	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
1	1.32	1.64	2.07	2.71	3.84	5.02	5.41	6.63	7.88	9.14	10.83	12.12
2	2.77	3.22	3.79	4.61	5.99	7.38	7.82	9.21	10.60	11.98	13.82	15.20
3	4.11	4.64	5.32	6.25	7.81	9.35	9.84	11.34	12.84	14.32	16.27	17.73
4	5.39	5.59	6.74	7.78	9.49	11.14	11.67	13.23	14.86	16.42	18.47	20.00
5	6.63	7.29	8.12	9.24	11.07	12.83	13.33	15.09	16.75	18.39	20.51	22.11
6	7.84	8.56	9.45	10.64	12.53	14.45	15.03	16.81	13.55	20.25	22.46	24.10
7	9.04	5.80	10.75	12.02	14.07	16.01	16.62	18.48	20.28	22.04	24.32	26.02
8	10.22	11.03	12.03	13.36	15.51	17.53	18.17	20.09	21.95	23.77	26.12	27.87
9	11.39	12.24	13.29	14.68	16.92	19.02	19.63	21.67	23.59	25.46	27.83	29.67
10	12.55	13.44	14.53	15.99	18.31	20.48	21.16	23.21	25.19	27.11	29.59	31.42
11	13.70	14.63	15.77	17.29	19.68	21.92	22.62	24.72	26.76	28.73	31.26	33.14
12	14.85	15.81	16.99	18.55	21.03	23.34	24.05	26.22	28.30	30.32	32.91	34.82
13	15.93	15.58	18.90	19.81	22.36	24.74	25.47	27.69	29.82	31.88	34.53	36.48
14	17.12	18.15	19.4	21.06	23.68	26.12	26.87	29.14	31.32	33.43	36.12	38.11
15	18.25	19.31	20.60	22.31	25.00	27.49	28.26	30.58	32.80	34.95	37.70	39.72
16	19.37	20.47	21.79	23.54	26.30	28.85	29.63	32.00	34.27	36.46	39.25	41.31
17	20.49	21.61	22.98	24.77	27.59	30.19	31.00	33.41	35.72	37.95	40.79	42.88
18	21.60	22.76	24.16	25.99	28.87	31.53	32.35	34.81	37.16	39.42	42.31	44.43
19	22.72	23.90	25.33	27.20	30.14	32.85	33.69	36.19	38.58	40.88	43.82	45.97
20	23.83	25.04	26.50	28.41	31.41	34.17	35.02	37.57	40.00	42.34	45.31	47.50
21	24.93	26.17	27.66	29.62	32.67	35.48	36.34	38.93	41.40	43.78	46.80	49.01
22	26.04	27.30	28.82	30.81	33.92	36.78	37.66	40.29	42.80	45.20	48.27	50.51
23	27.14	28.43	29.98	32.01	35.17	38.08	38.97	41.64	44.18	46.62	49.73	52.00
24	28.24	29.55	31.13	33.20	36.42	39.36	40.27	42.98	45.56	48.03	51.18	53.48
25	29.34	30.68	32.28	34.38	37.65	40.65	41.57	44.31	46.93	49.44	52.62	54.95
26	30.43	31.79	33.43	35.56	38.89	41.92	42.86	45.64	48.29	50.83	54.05	56.41
27	31.53	32.91	34.57	36.74	40.11	43.19	44.14	46.96	49.64	52.22	55.48	57.86
28	32.62	34.03	35.71	37.92	41.34	44.46	45.42	48.28	50.99	53.59	56.89	59.30

Was Mendel Right?

χ^2 Analysis

$$\begin{aligned}\chi^2 &= \sum \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}} \\ &= \frac{(705 - 697)^2}{697} + \frac{(224 - 232)^2}{232} \\ &= 0.368\end{aligned}$$

P value \approx 55%

Was Mendel Right? χ^2 Analysis

Therefore there's a
55% chance my
hypothesis is correct

P value \approx 55%

Was Mendel Right? χ^2 Analysis

How can we do better?

Replicate the experiment!



*How can we replicate
an F1 cross lots of times?*

Strategy for Mendel simulation

1. Define male genotype as "Pp"
2. Define female genotype as same
3. Choose gamete from male and female, using CHOOSE-FROM
4. Join gametes using JOIN
5. Obtain 929 progeny, using APPLY-FUNCTION
6. Count the number of "pp" progeny.
7. Package all of this into a new function, using DEFINE-FUNCTION
8. Write a loop that goes through 100 trials. Count the trial if the deviation from the expected result is at least as great as Mendel's result of 224.