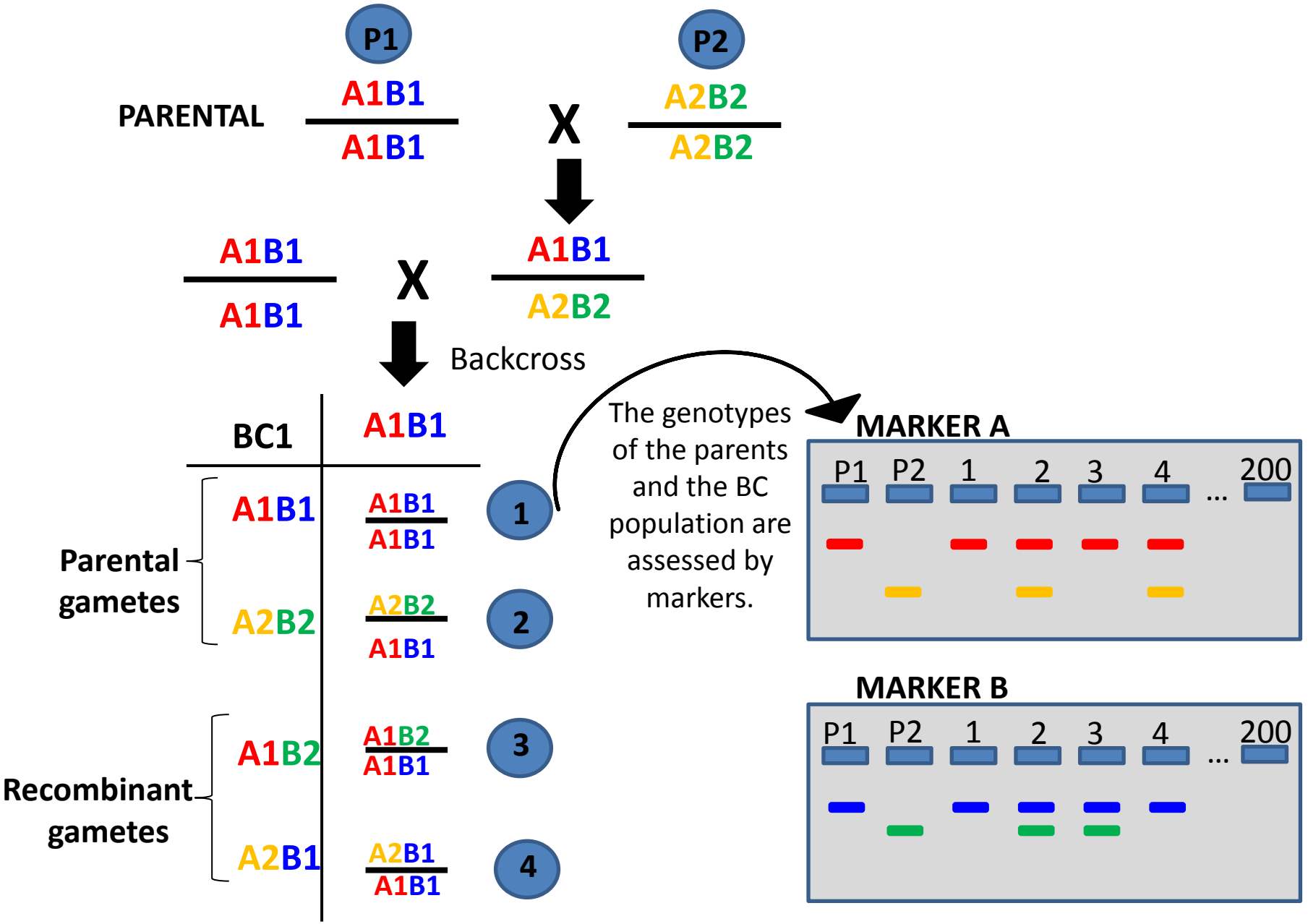
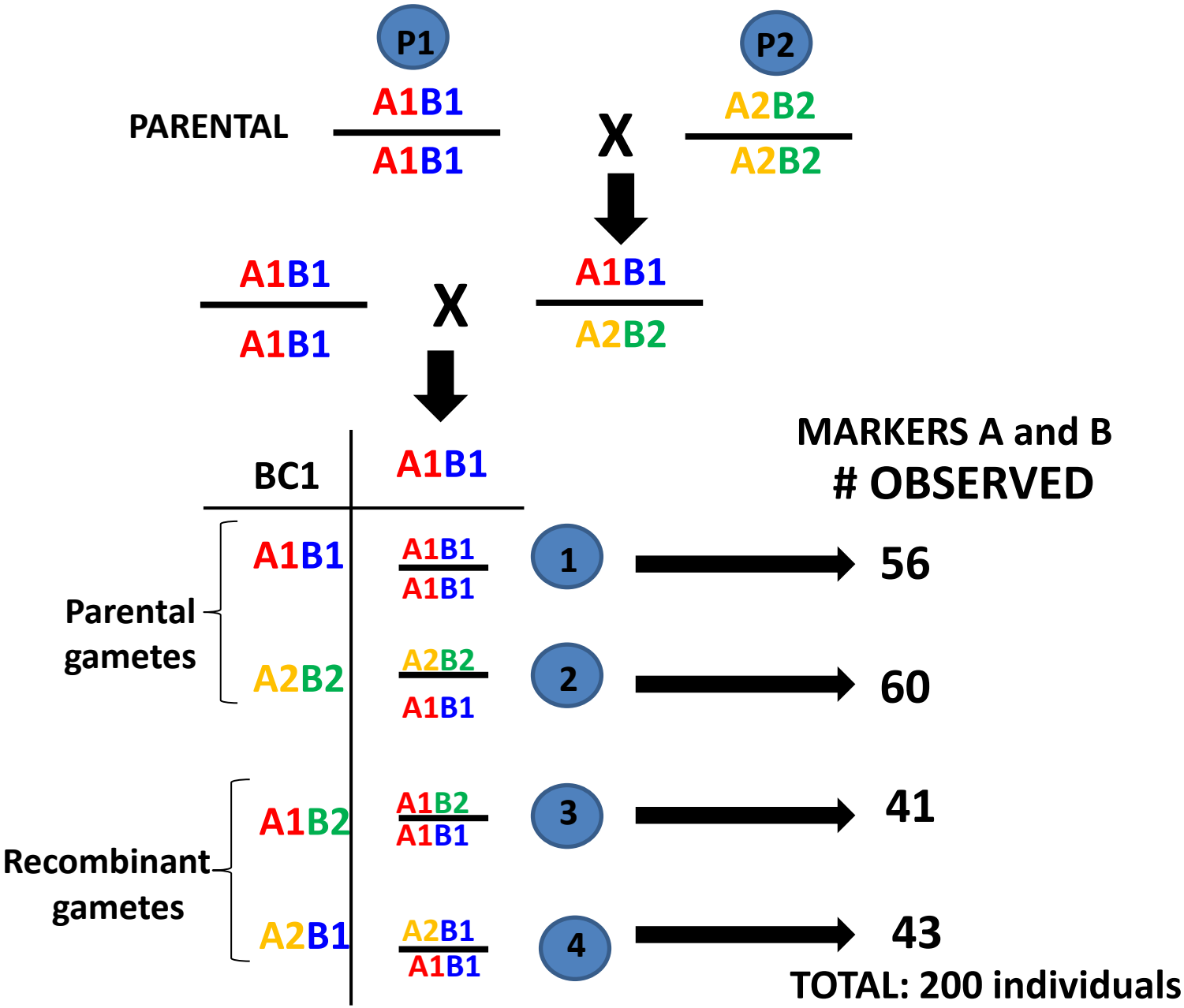
LOD SCORE:
Toy example

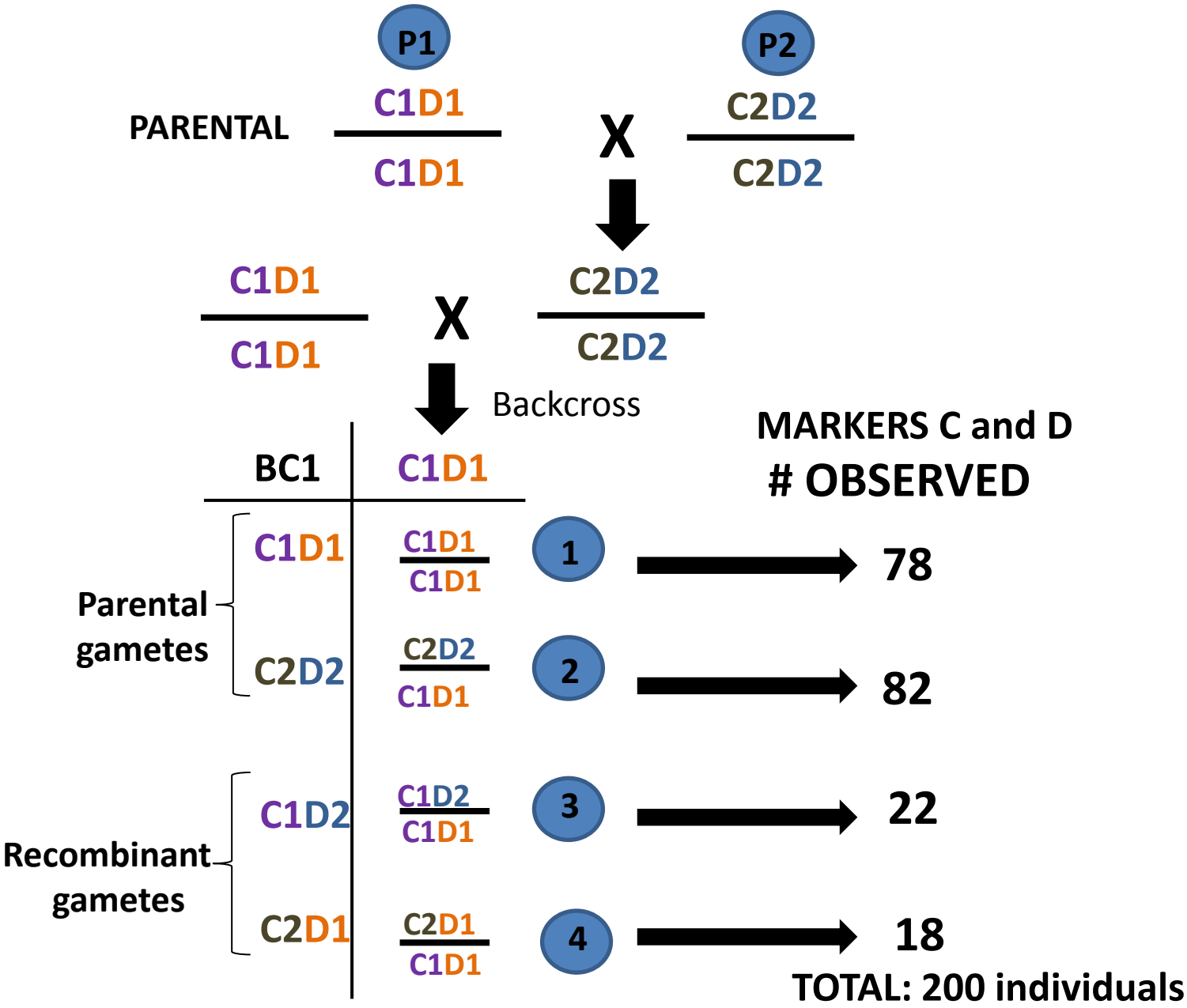
Backcross Mapping Population



Backcross Population: evaluation of markers A and B



Backcross Population: evaluation of markers C and D



Recombinant Fraction (r)

$$r = \frac{\text{\# recombinants}}{(\text{\# recombinants}) + (\text{\# parental})}$$

This is the maximum likelihood estimate (MLE) of r

$$\hat{r} = \frac{n_r}{n_r + n_p}$$

MARKERS A and B:

$$r = \frac{(41+43)}{(41+43) + (56+60)} = 0.42$$

MARKERS C and D:

$$r = \frac{(22+18)}{(22+18) + (78+82)} = 0.20$$

LOD SCORE

$$\text{LOD} = \log_{10}\left[\frac{\theta^{R} \times (1-\theta)^{NR}}{(0.5)^{NR+R}}\right]$$

θ represents the recombination fraction (r)
R, the number of recombinant offspring
NR, the number of non-recombinant offspring (parental)
0.5 at the denominator refers to the 50% chance of recombination due to independent assortment (markers are completely unlinked)

MARKERS A and B:

$$\text{LOD} = \log_{10}\left[\frac{0.42^{84} \times (1-0.42)^{116}}{(0.5)^{200}}\right] = 1.116587$$

MARKERS C and D:

$$\text{LOD} = \log_{10}\left[\frac{0.20^{40} \times (1-0.20)^{160}}{(0.5)^{200}}\right] = 16.7416$$

LOD SCORE

Considering a **LOD score** of **3** as threshold value:

LOD $_{AB}$= 1.116587 → **A** and **B** are **unlinked**

LOD $_{CD}$ = 16.7416 → **C** and **D** are **linked**