

Fig. 24-1





**(a) Similarity between different species**



**(b) Diversity within a species**



## **(a) Similarity between different species**

Fig. 24-2b

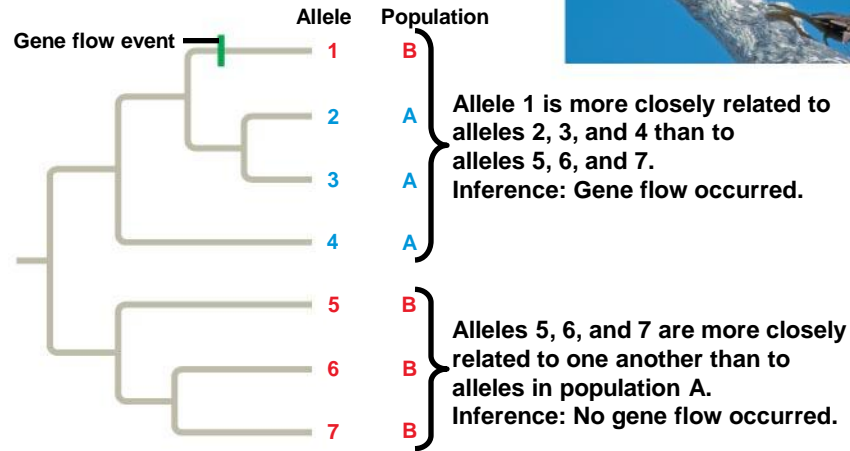


## **(b) Diversity within a species**

Fig. 24-3

## EXPERIMENT

▼ Example of a gene tree for population pair A-B

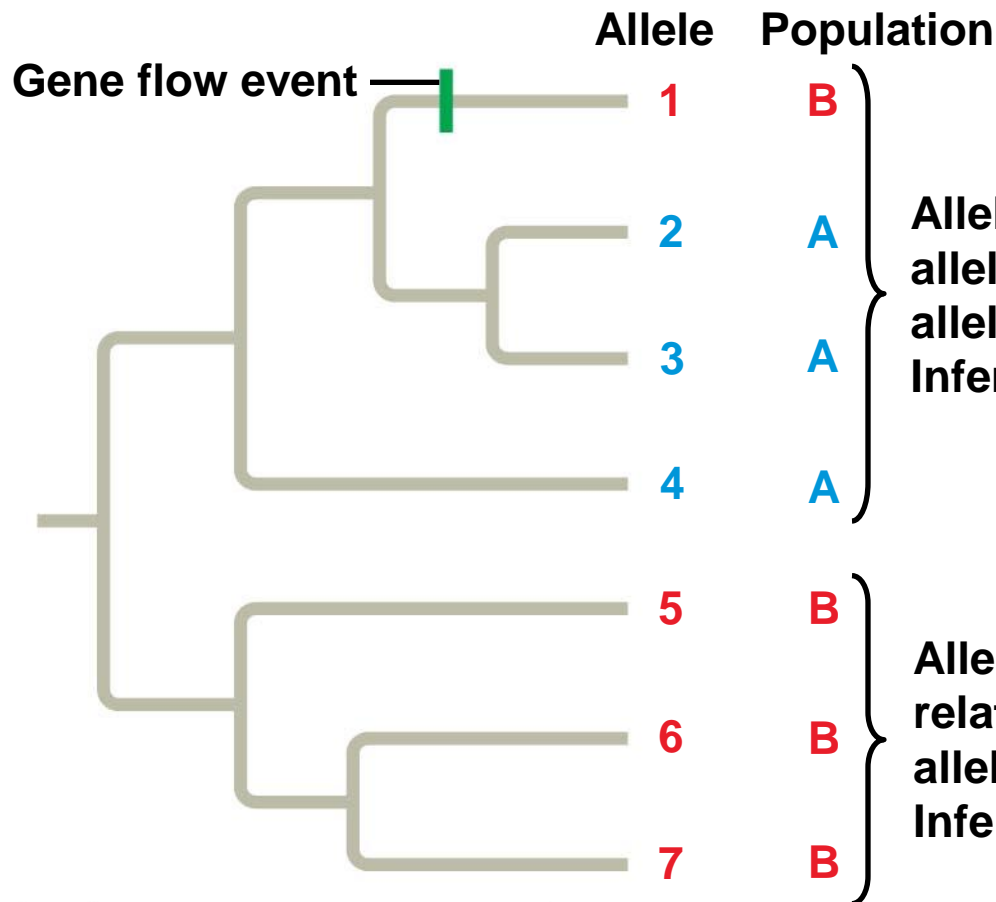


## RESULTS

| Pair of populations with detected gene flow | Estimated minimum number of gene flow events to account for genetic patterns | Distance between populations (km) |
|---|--|-----------------------------------|
| A-B   | 5  | 340                               |
| K-L   | 3  | 720                               |
| A-C   | 2-3  | 1,390                             |
| B-C   | 2  | 1,190                             |
| F-G   | 2  | 760                               |
| G-I   | 2  | 1,110                             |
| C-E   | 1-2  | 1,310                             |

## EXPERIMENT

▼ Example of a gene tree for population pair A-B



Allele 1 is more closely related to alleles 2, 3, and 4 than to alleles 5, 6, and 7.  
**Inference: Gene flow occurred.**

Alleles 5, 6, and 7 are more closely related to one another than to alleles in population A.  
**Inference: No gene flow occurred.**



## RESULTS

| <b>Pair of populations with detected gene flow</b> | <b>Estimated minimum number of gene flow events to account for genetic patterns</b> | <b>Distance between populations (km)</b> |
|--|---|--|
| <b>A-B</b>   | <b>5</b>  | <b>340</b>                               |
| <b>K-L</b>   | <b>3</b>  | <b>720</b>                               |
| <b>A-C</b>   | <b>2–3</b>  | <b>1,390</b>                             |
| <b>B-C</b>   | <b>2</b>  | <b>1,190</b>                             |
| <b>F-G</b>   | <b>2</b>  | <b>760</b>                               |
| <b>G-I</b>   | <b>2</b>  | <b>1,110</b>                             |
| <b>C-E</b>   | <b>1–2</b>  | <b>1,310</b>                             |

Fig. 24-3c



## Grey-crowned babbler

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Fig. 24-4

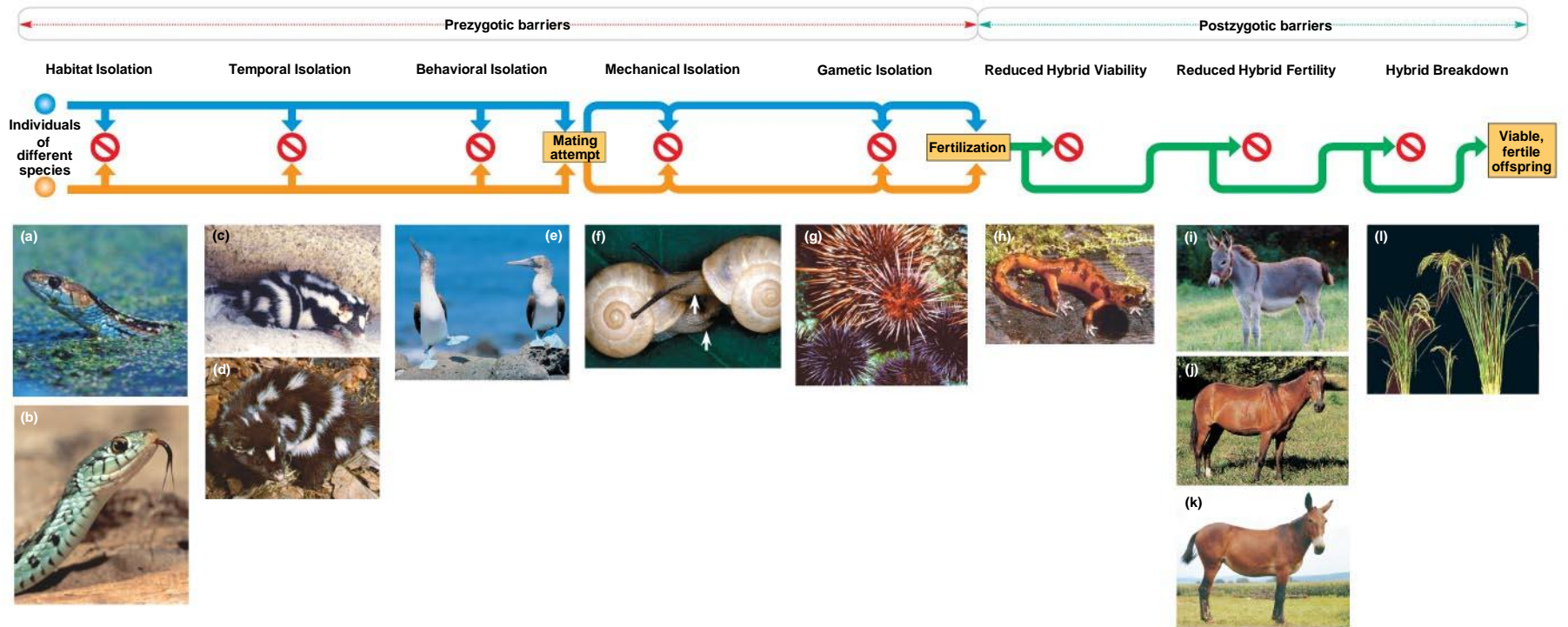


Fig. 24-4a

Prezygotic barriers

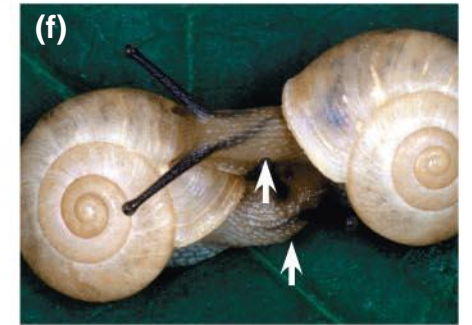
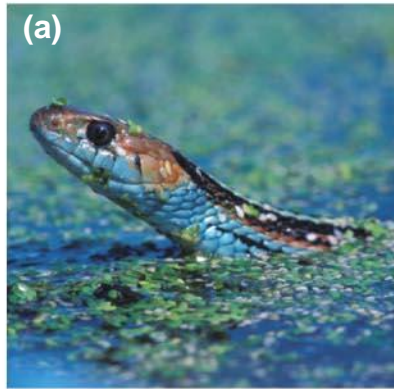
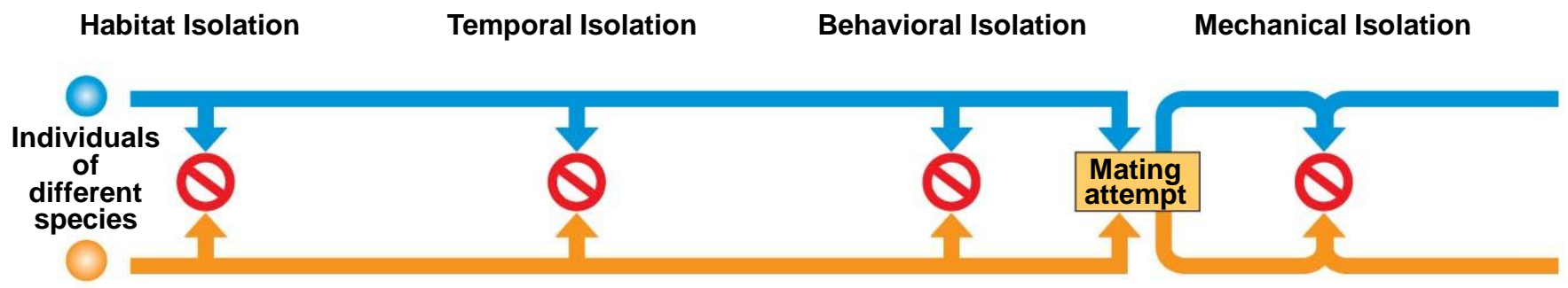
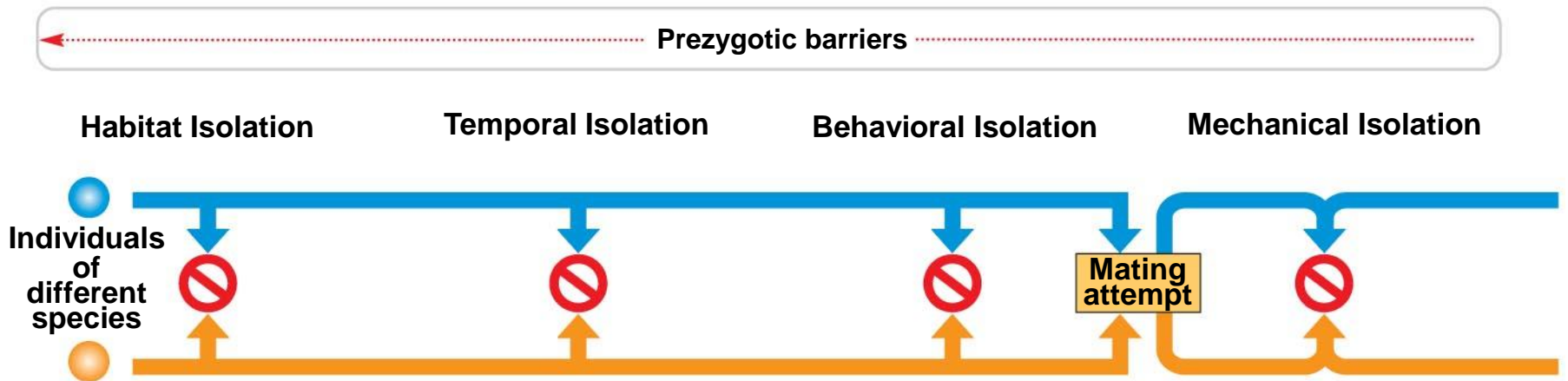


Fig. 24-4b





## Water-dwelling *Thamnophis*

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## Terrestrial *Thamnophis*

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**Eastern spotted skunk**  
***(Spilogale putorius)***

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**Western spotted skunk**  
***(Spilogale gracilis)***

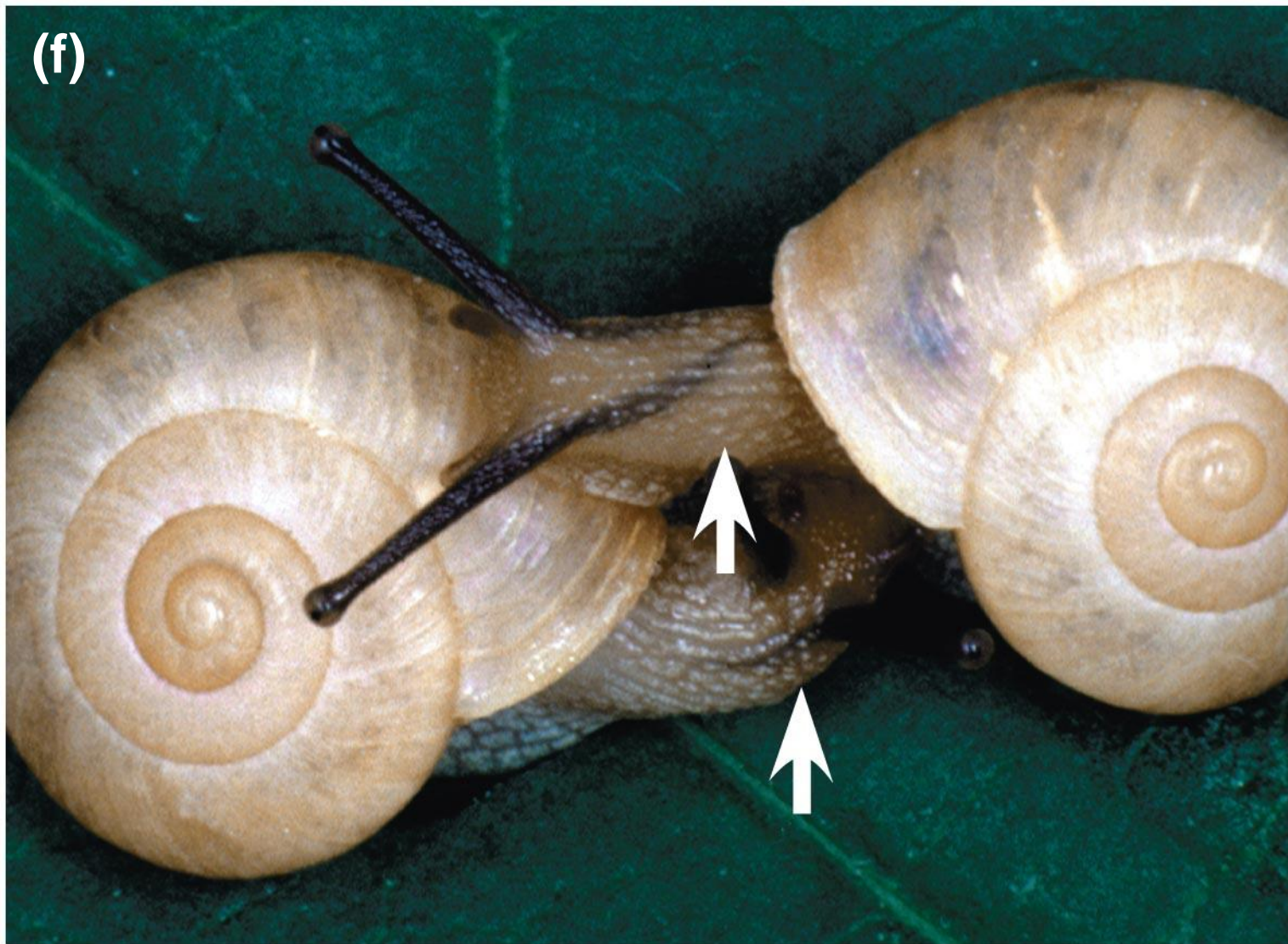
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## Courtship ritual of blue-footed boobies

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***Bradybaena* with shells spiraling in opposite directions**

Fig. 24-4i

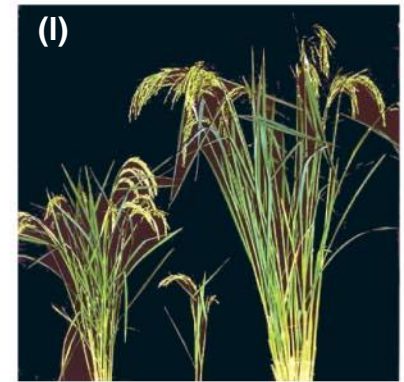
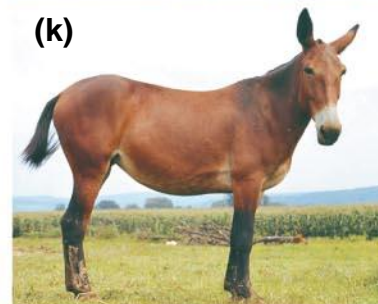
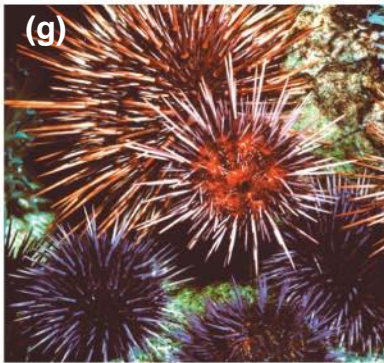
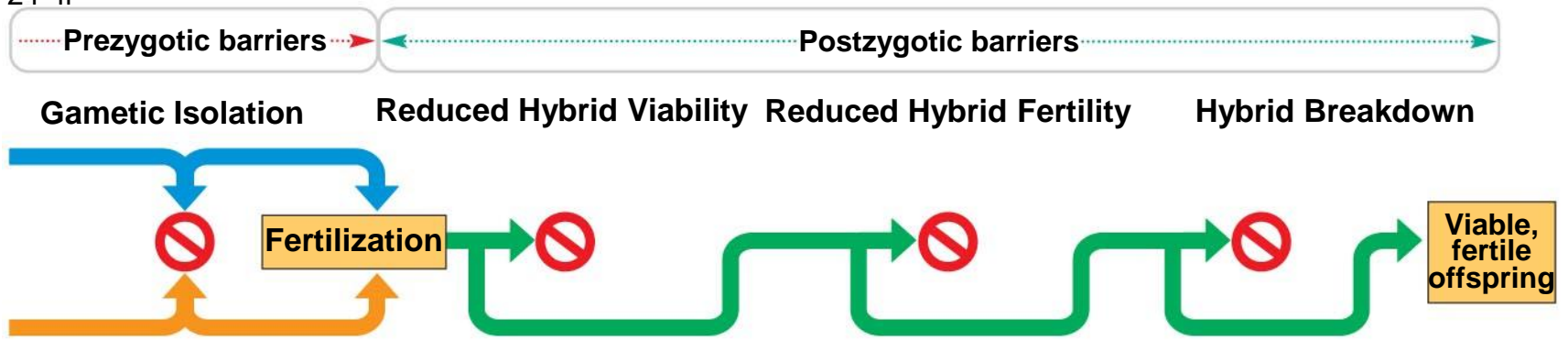
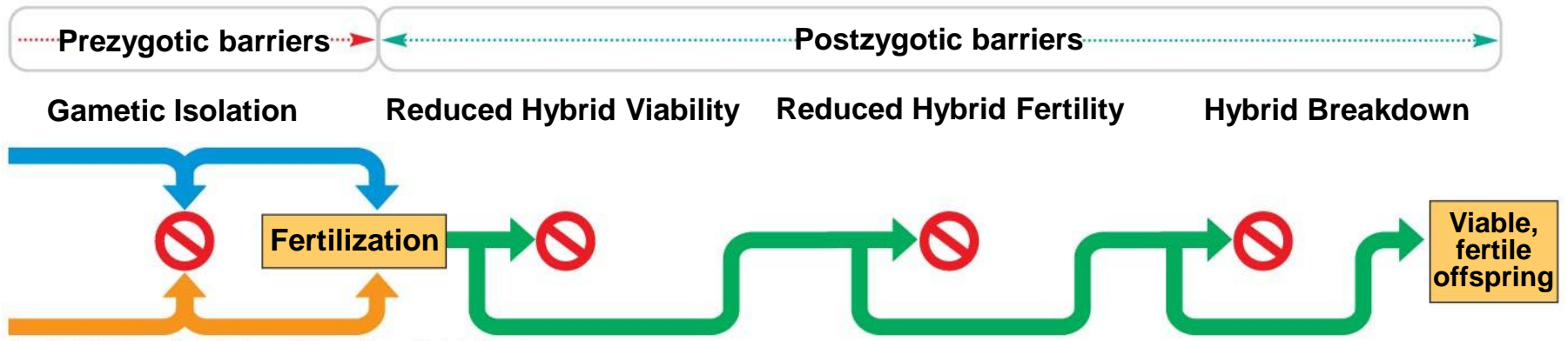
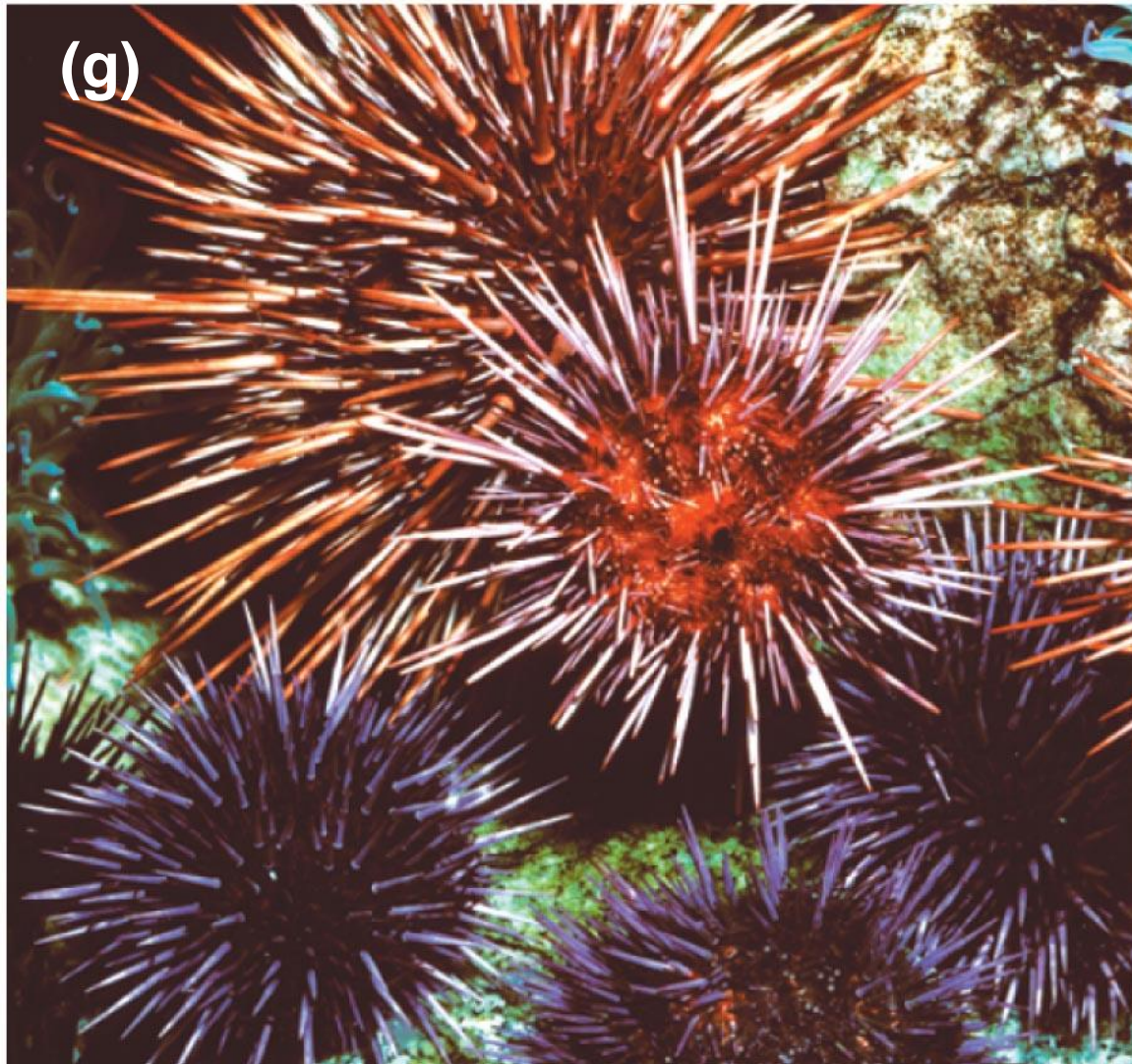


Fig. 24-4j





## Sea urchins

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***Ensatina* hybrid**

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# Donkey

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## Horse

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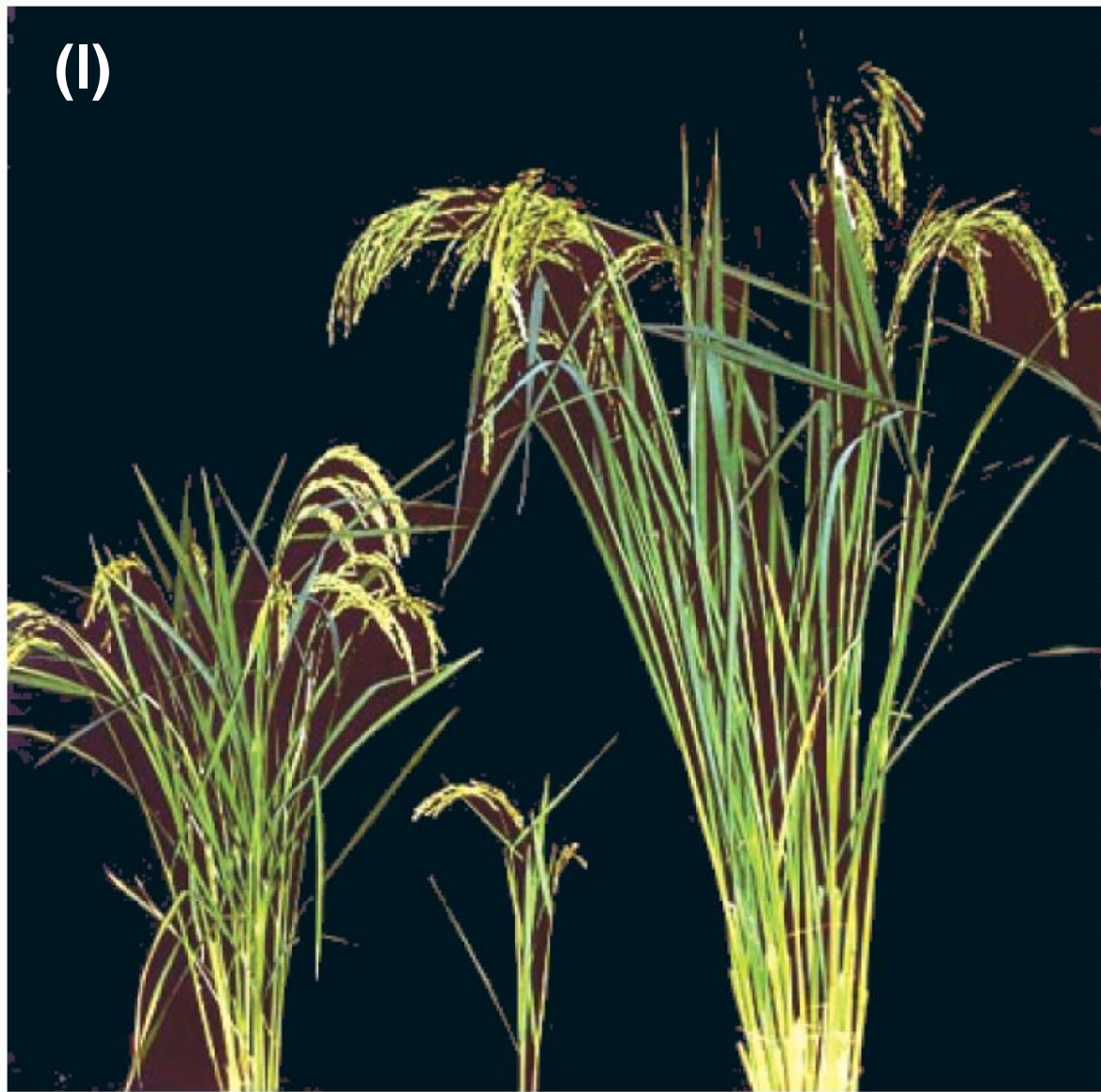
**(k)**



## **Mule (sterile hybrid)**

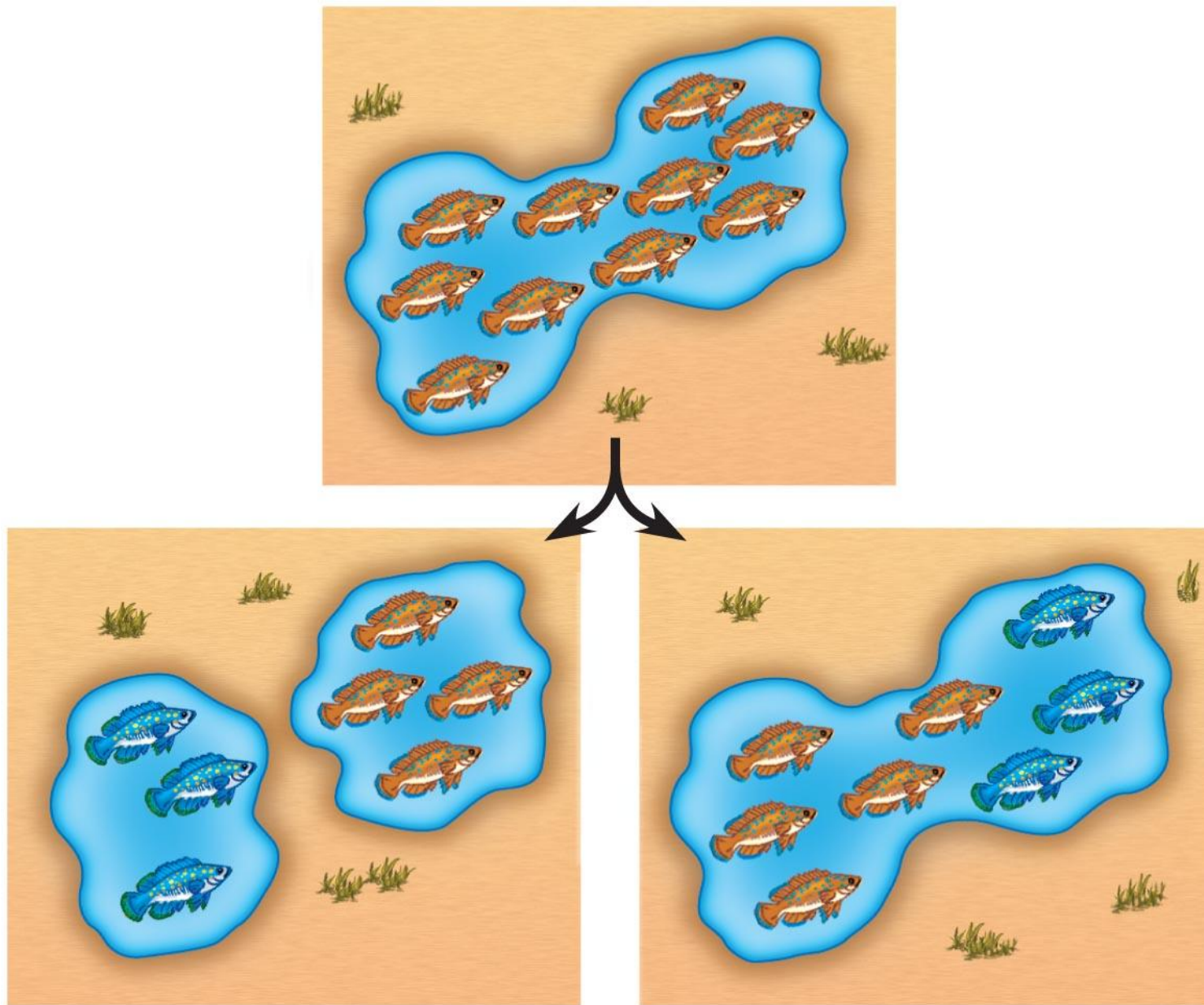
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**Hybrid cultivated rice plants with stunted offspring (center)**

Fig. 24-5



**(a) Allopatric speciation**

**(b) Sympatric speciation**



Fig. 24-7

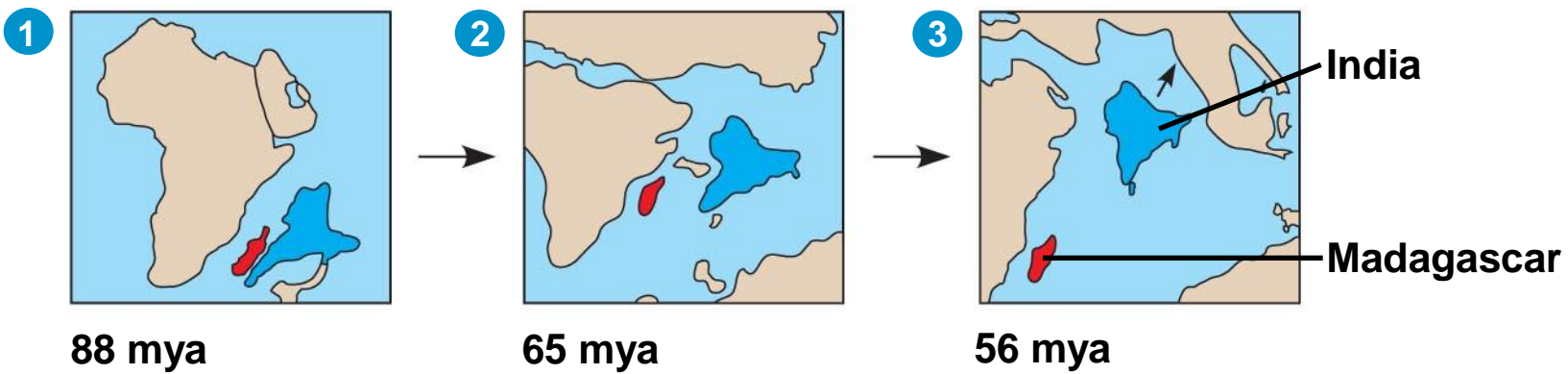
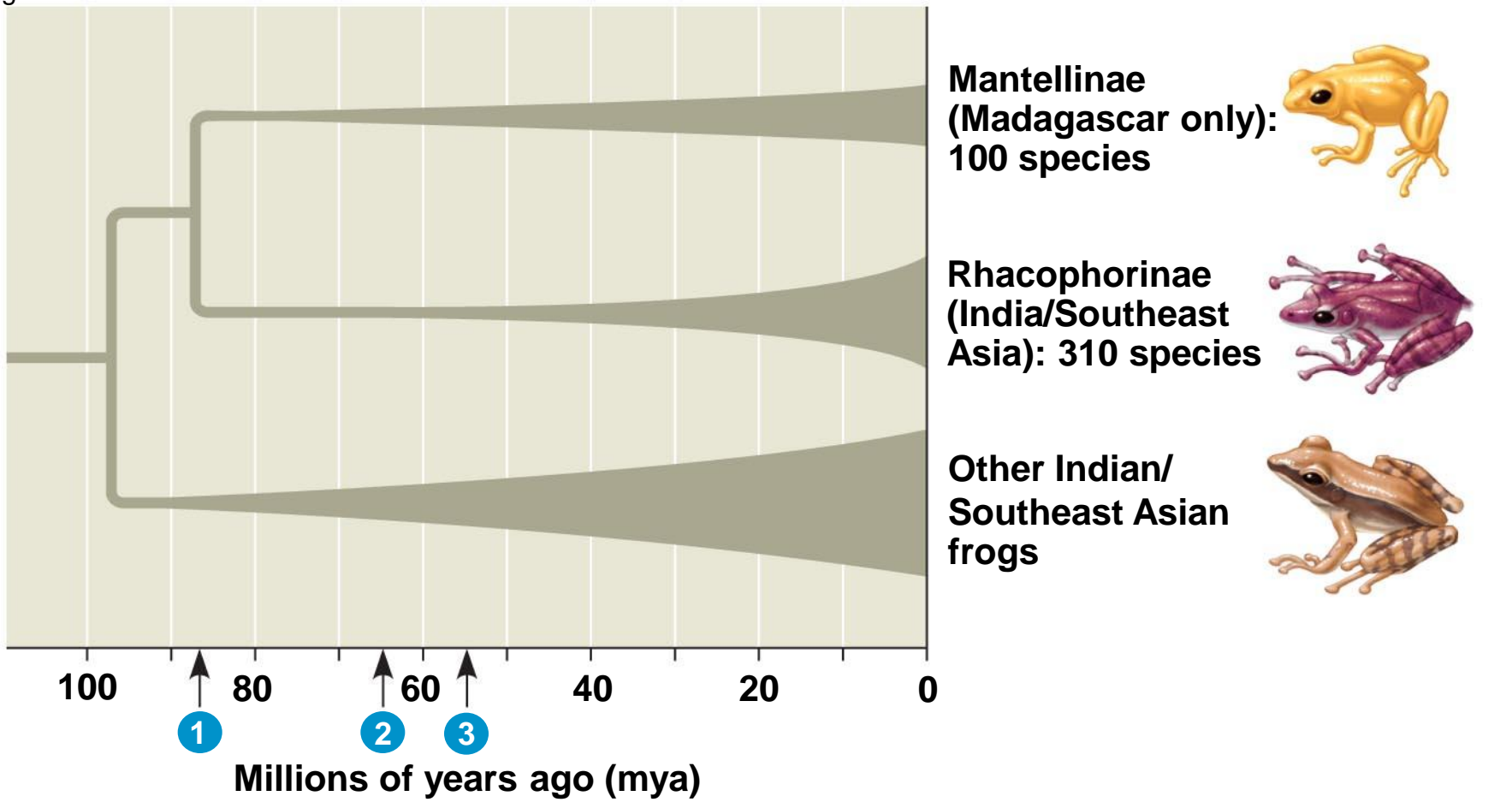
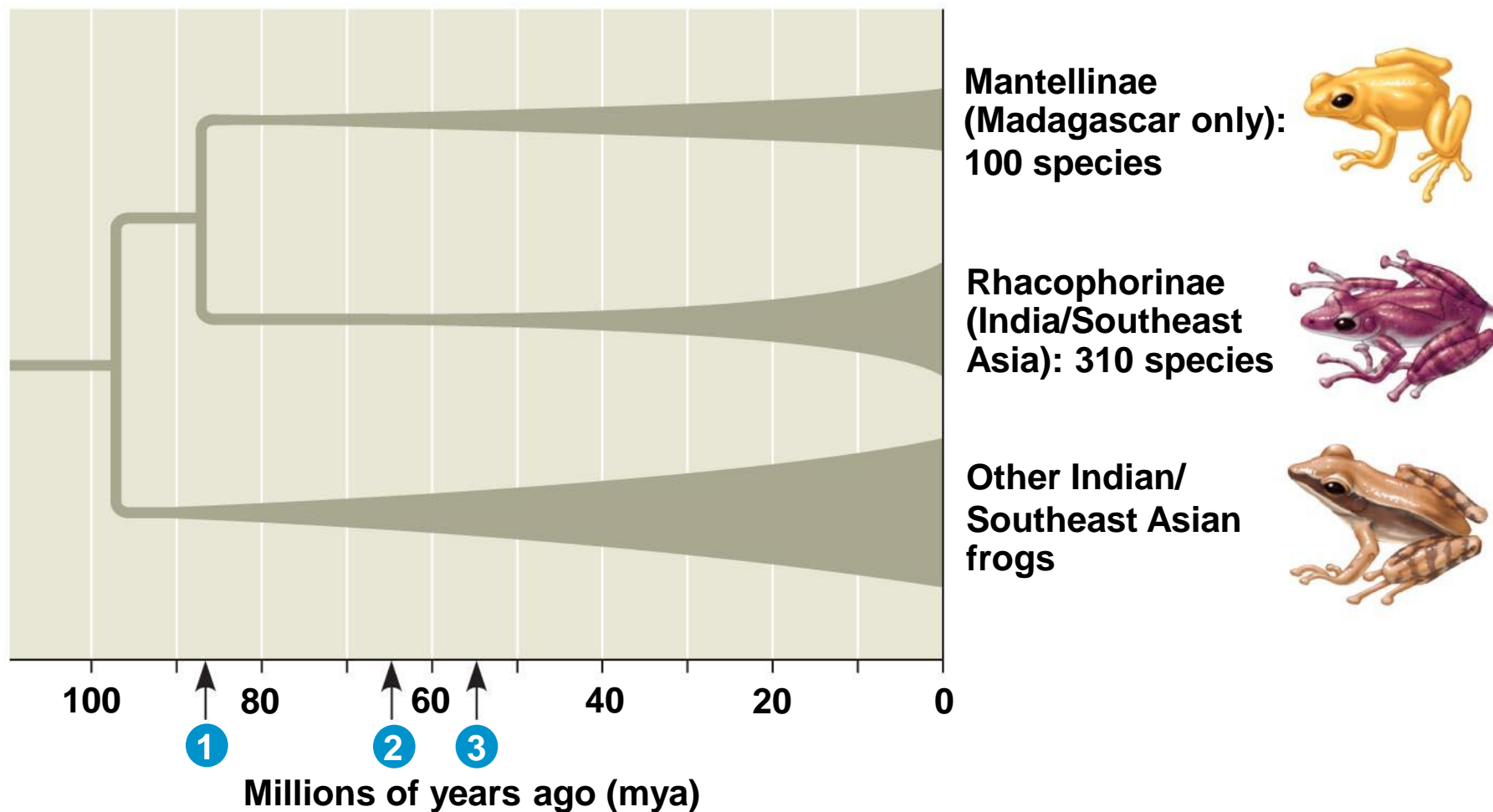


Fig. 24-7a



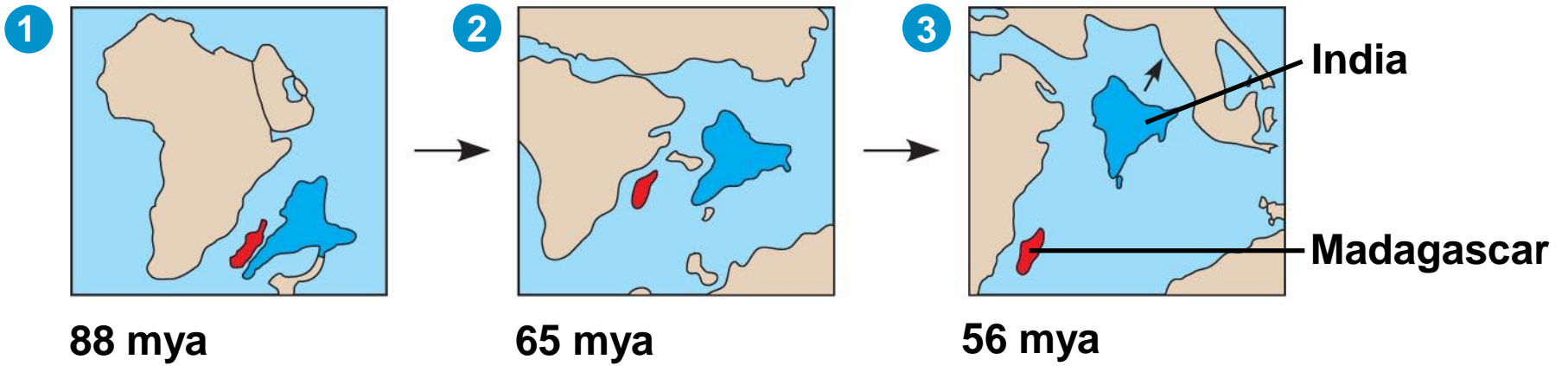


Fig. 24-8

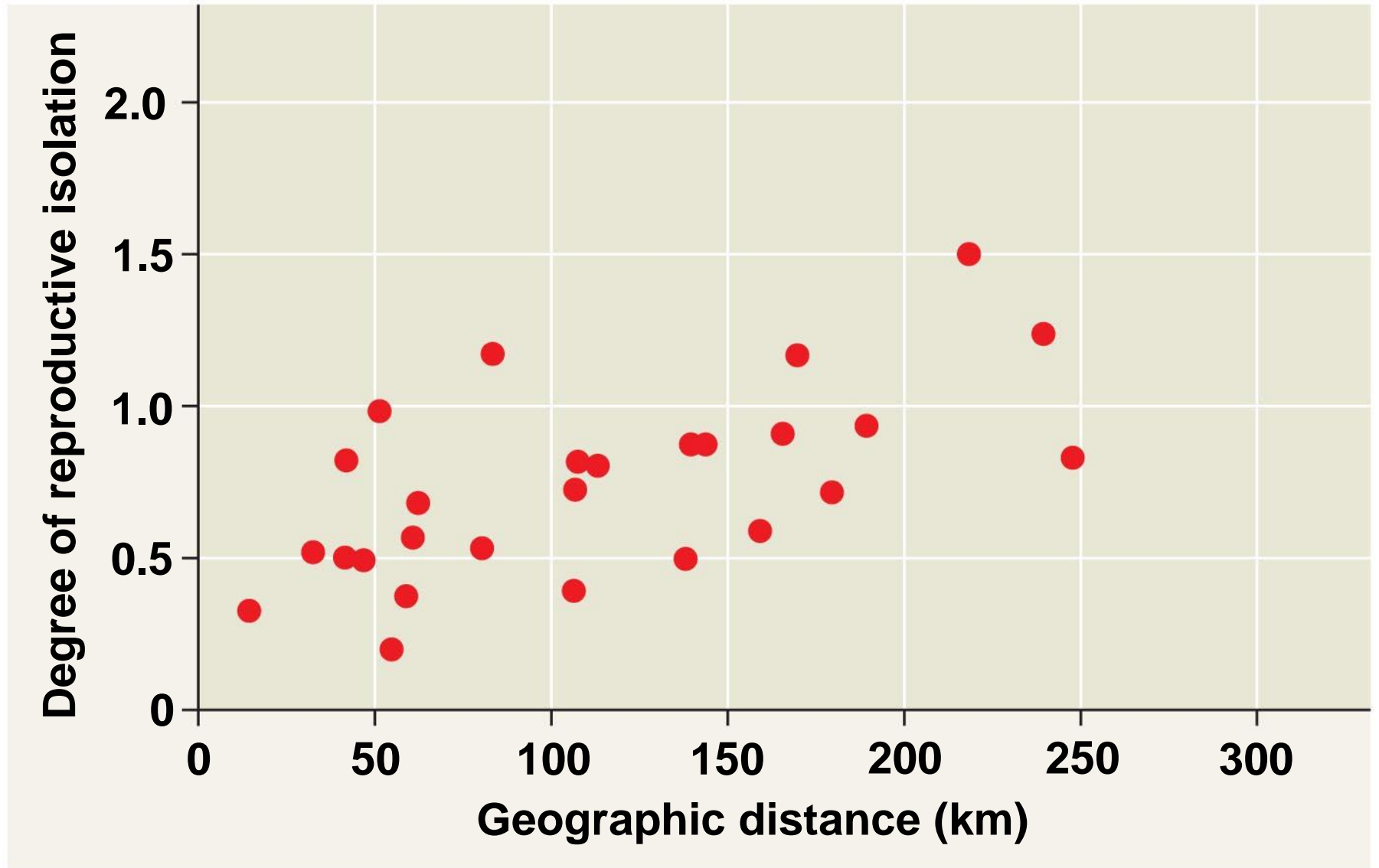
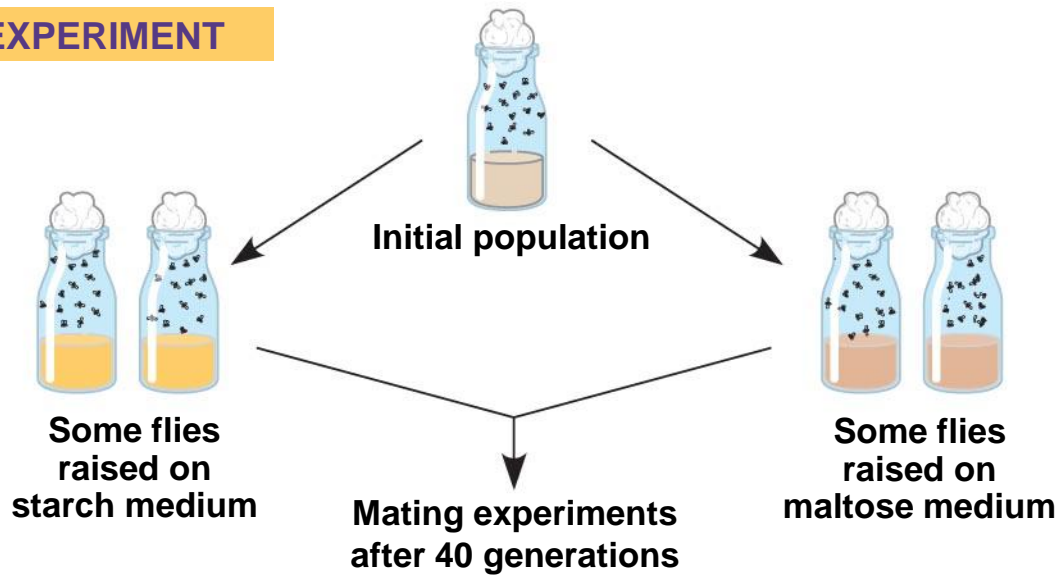


Fig. 24-9

**EXPERIMENT**



**RESULTS**

|      |         | Female |         |
|------|---------|--------|---------|
|      |         | Starch | Maltose |
| Male | Starch  | 22     | 9       |
|      | Maltose | 8      | 20      |

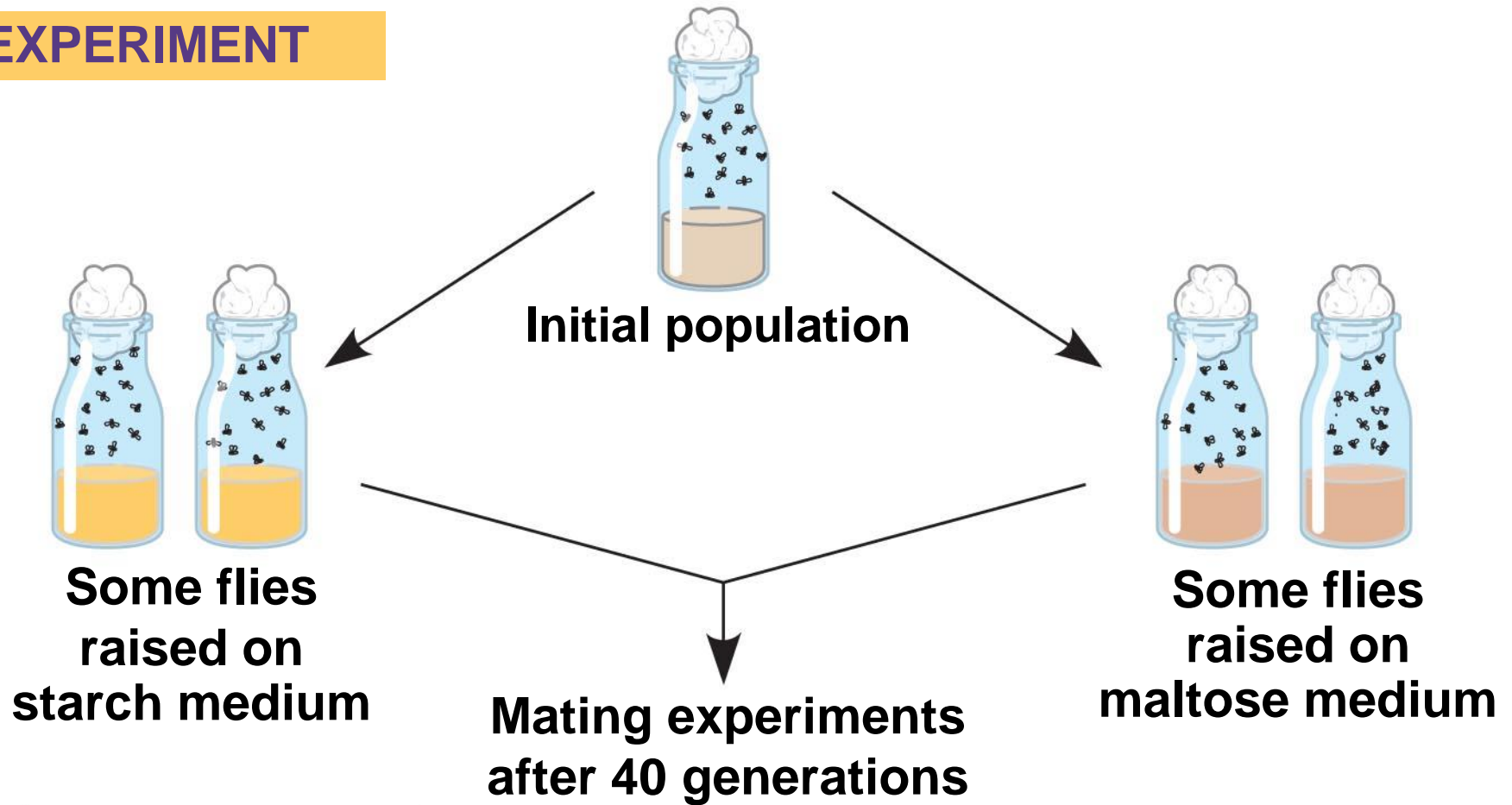
Mating frequencies in experimental group

|      |                     | Female              |                     |
|------|---------------------|---------------------|---------------------|
|      |                     | Starch population 1 | Starch population 2 |
| Male | Starch population 1 | 18                  | 15                  |
|      | Starch population 2 | 12                  | 15                  |

Mating frequencies in control group



## EXPERIMENT



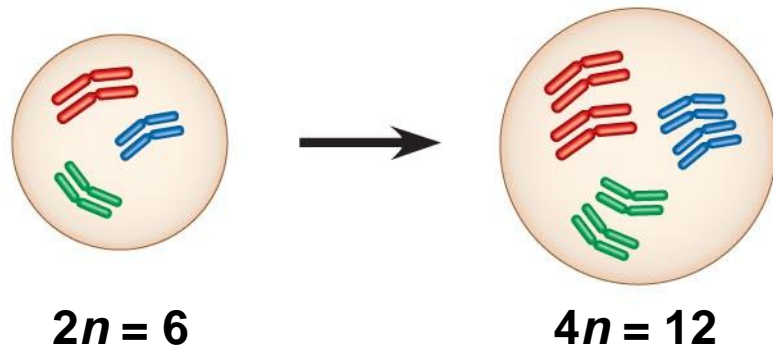
## RESULTS

|      |         | Female |         |
|------|---------|--------|---------|
|      |         | Starch | Maltose |
| Male | Starch  | 22     | 9       |
|      | Maltose | 8      | 20      |

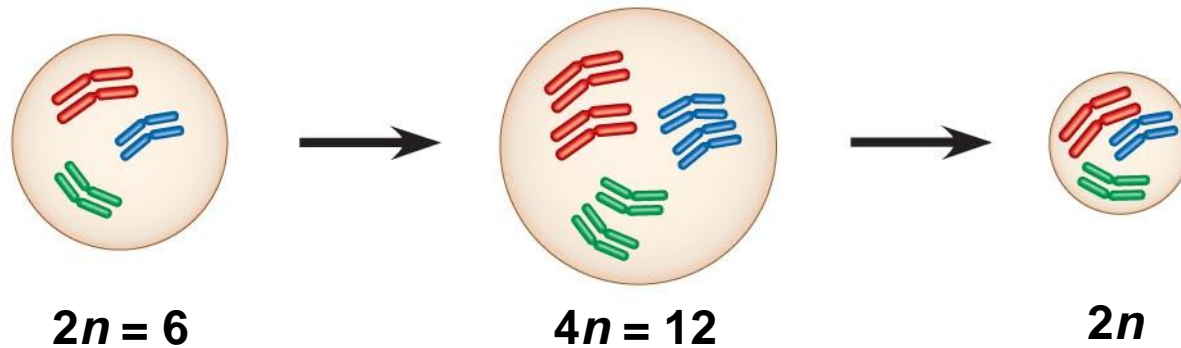
**Mating frequencies in experimental group**

|      |                     | Female              |                     |
|------|---------------------|---------------------|---------------------|
|      |                     | Starch population 1 | Starch population 2 |
| Male | Starch population 1 | 18                  | 15                  |
|      | Starch population 2 | 12                  | 15                  |

**Mating frequencies in control group**



**Failure of cell  
division after  
chromosome  
duplication gives  
rise to tetraploid  
tissue.**



$2n = 6$

$4n = 12$

$2n$

**Failure of cell  
division after  
chromosome  
duplication gives  
rise to tetraploid  
tissue.**

**Gametes  
produced  
are diploid.**

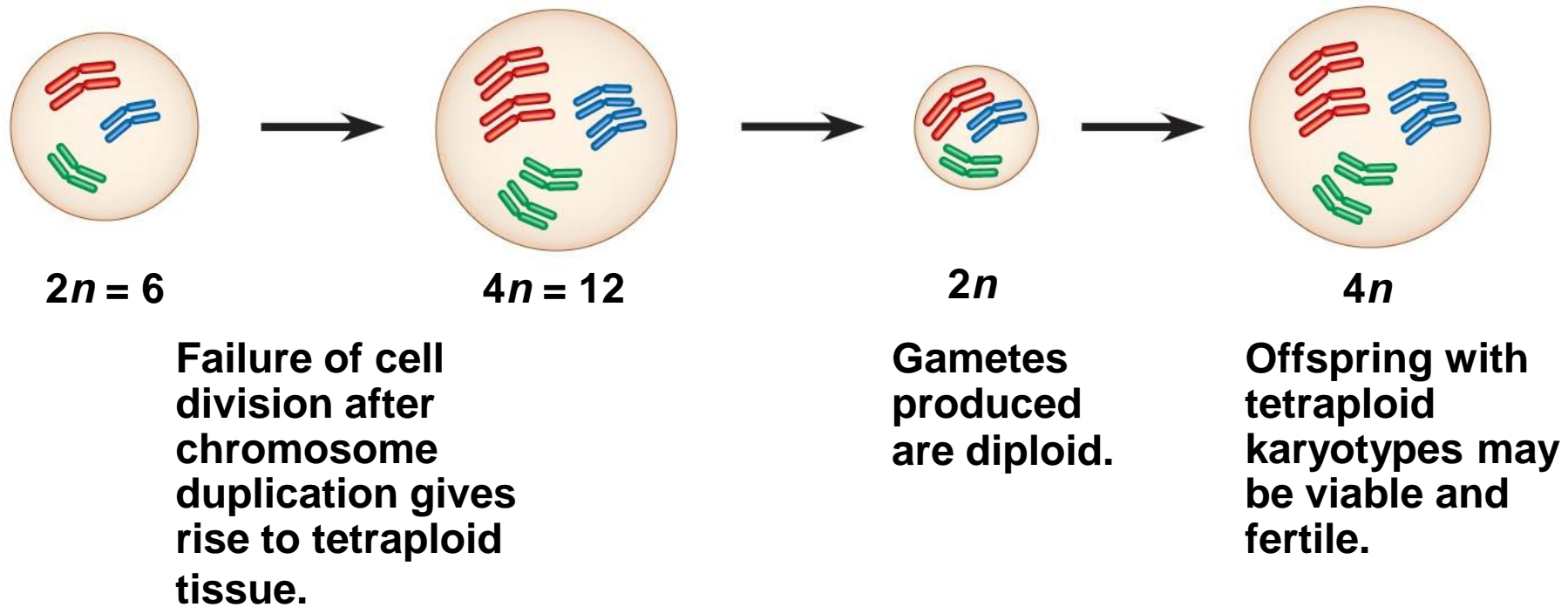
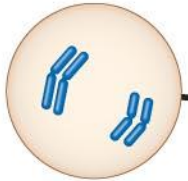


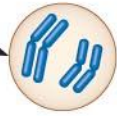
Fig. 24-11-1

**Species B**  
 $2n = 4$

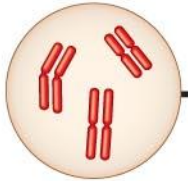


**Meiotic error**

**Unreduced gamete with 4 chromosomes**



**Species A**  
 $2n = 6$



**Normal gamete**  
 $n = 3$

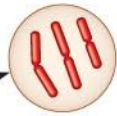


Fig. 24-11-2

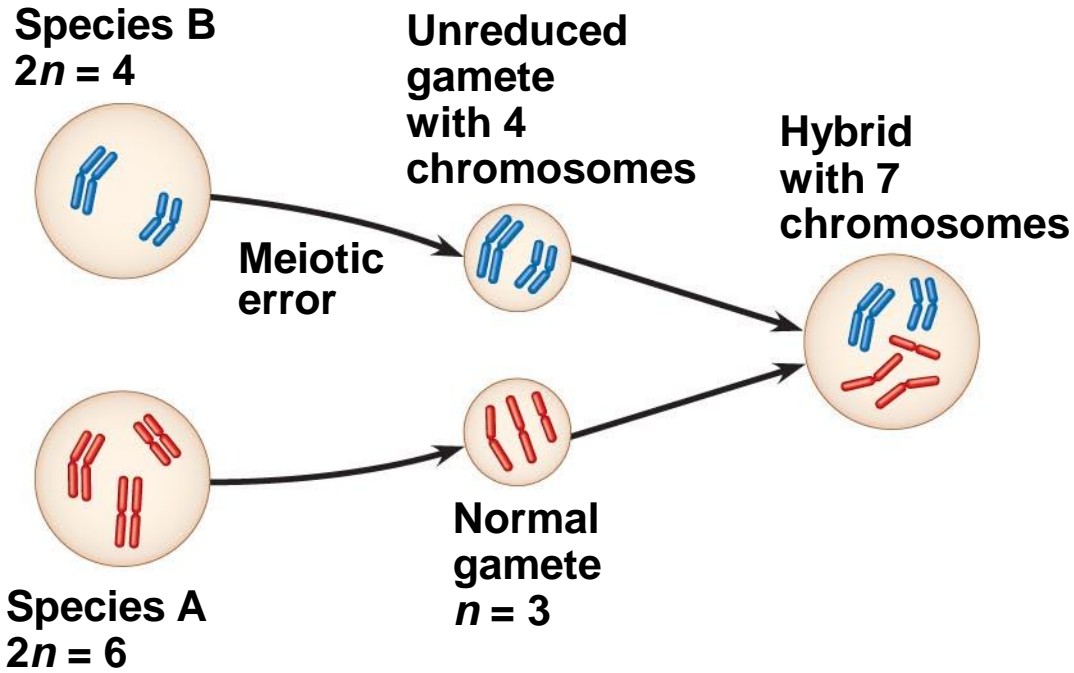


Fig. 24-11-3

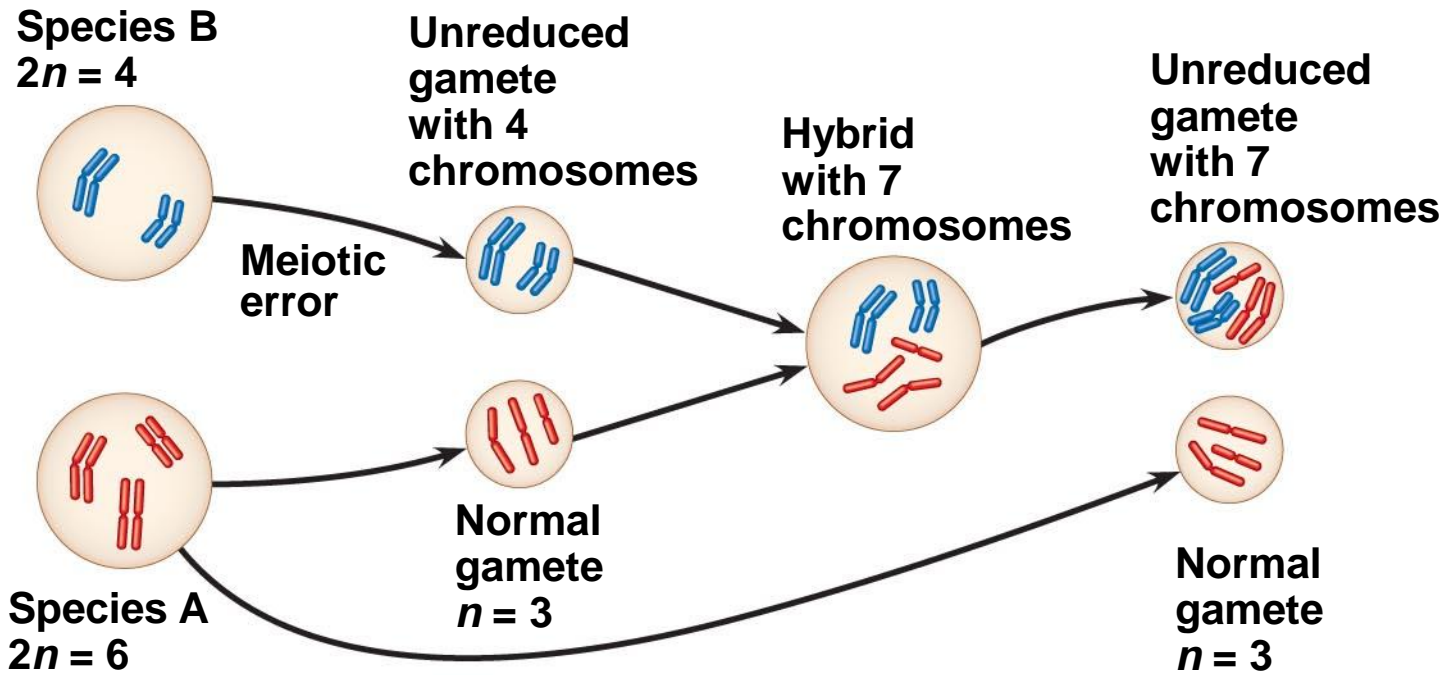
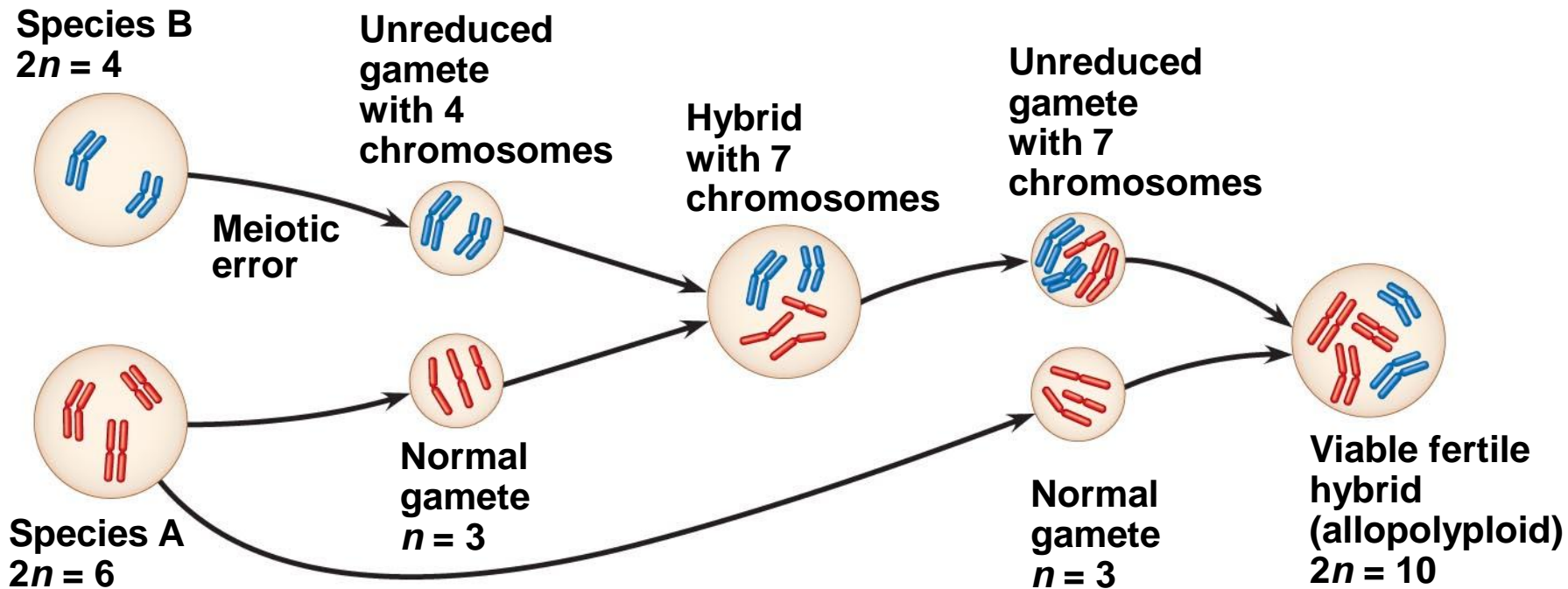




Fig. 24-11-4



## EXPERIMENT

**Normal light**

**Monochromatic  
orange light**

***P.  
pundamilia***



***P. nyererei***

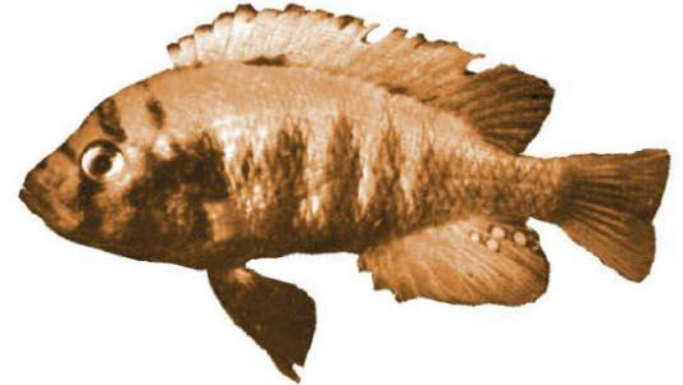
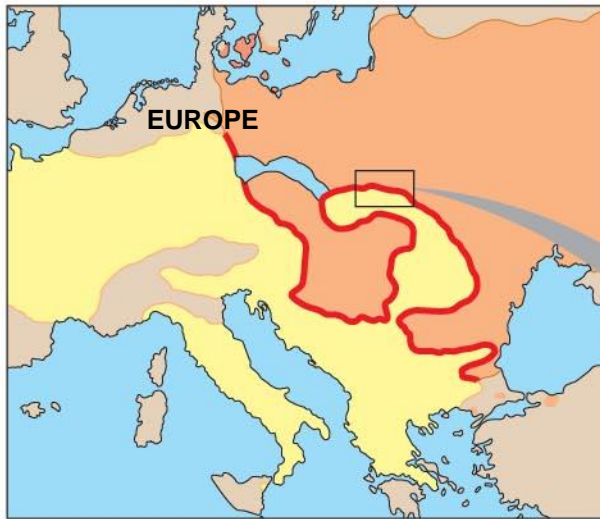


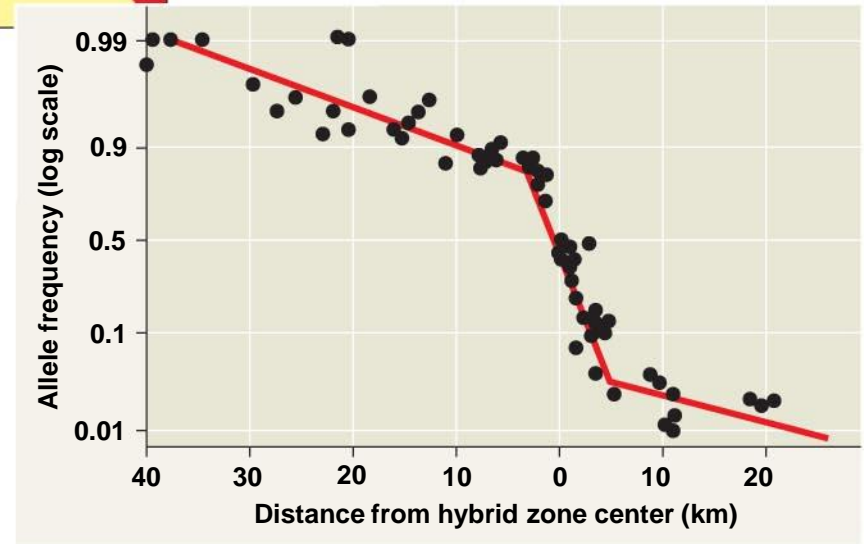
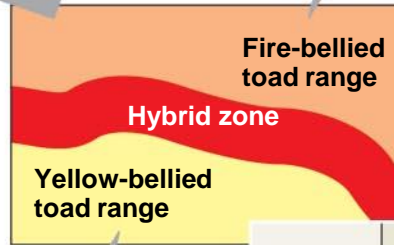
Fig. 24-13



Yellow-bellied toad,  
*Bombina variegata*



Fire-bellied toad,  
*Bombina orientalis*





**Yellow-bellied toad,  
*Bombina variegata***



**Fire-bellied toad,**  
***Bombina bombina***

Fig. 24-13c

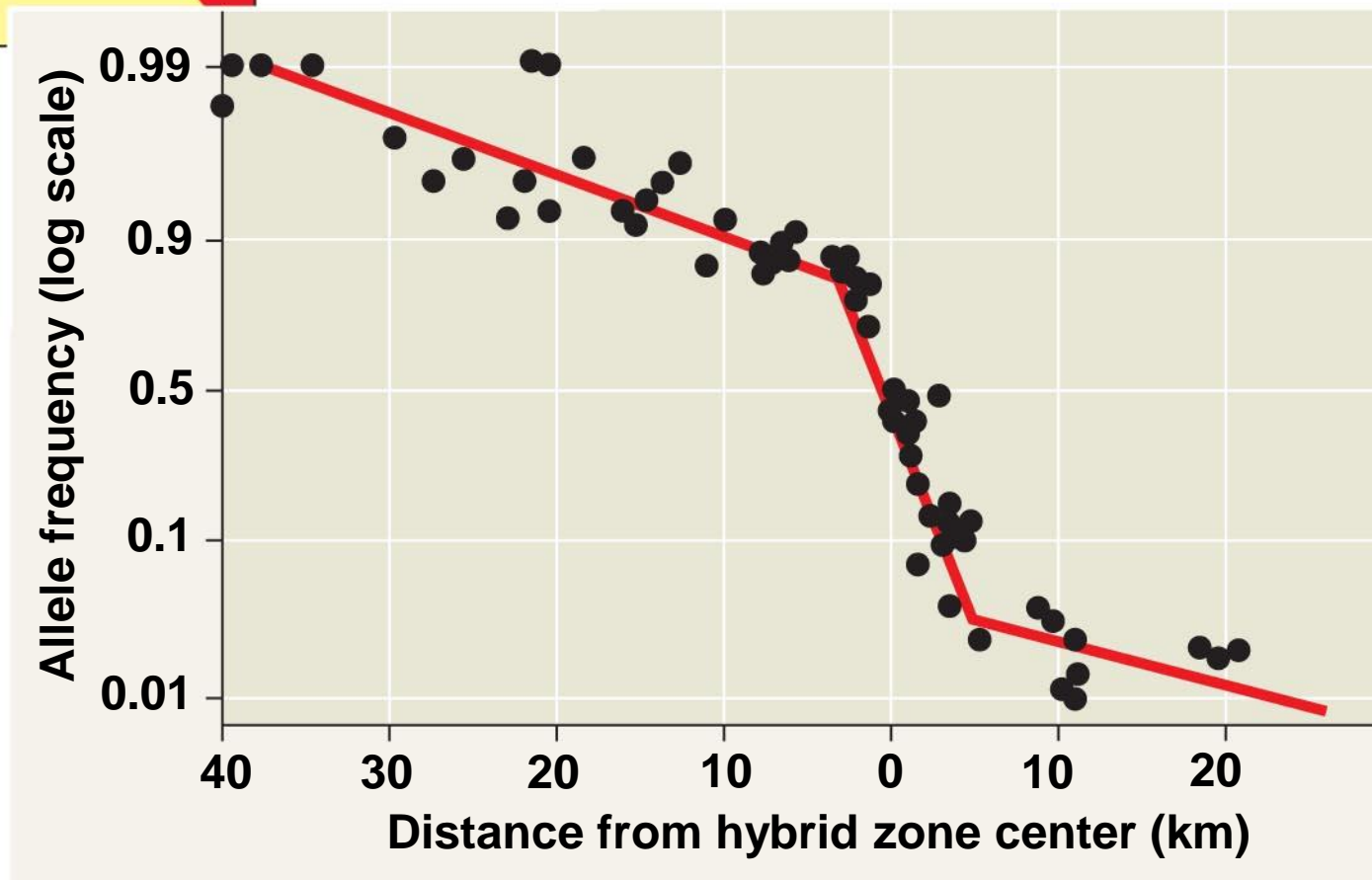
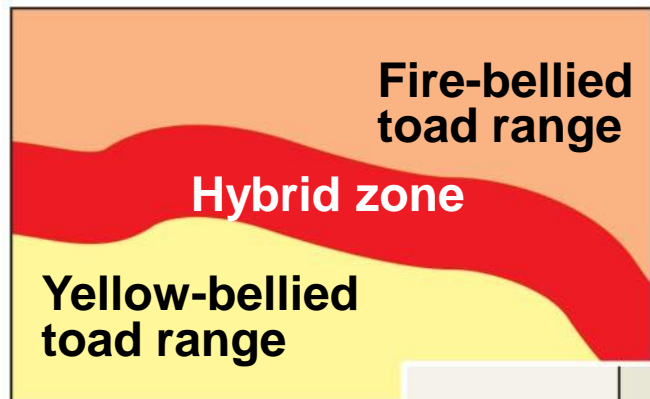


Fig. 24-14-1

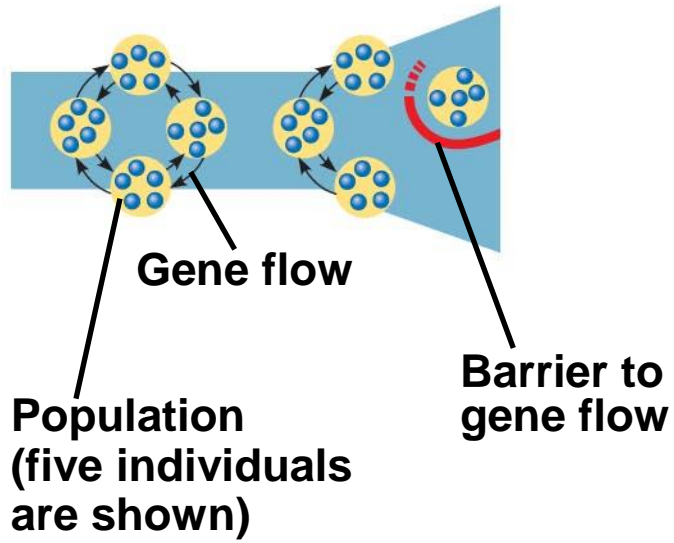


Fig. 24-14-2

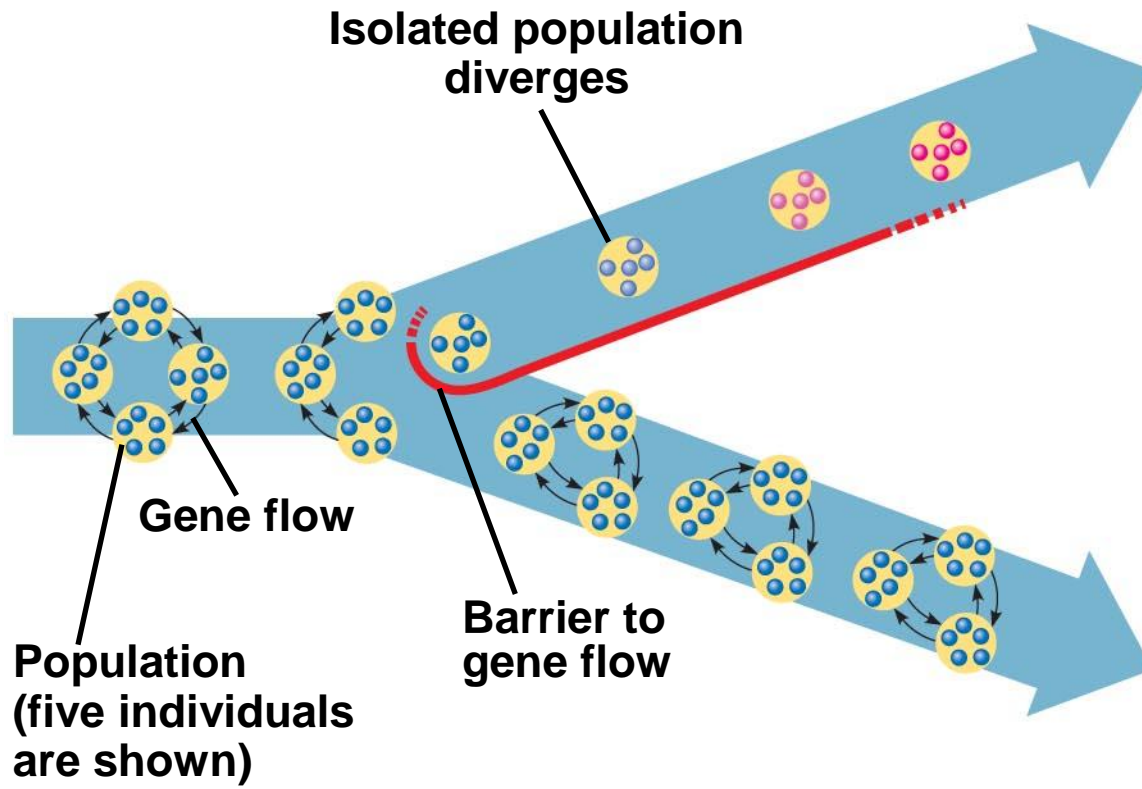




Fig. 24-14-3

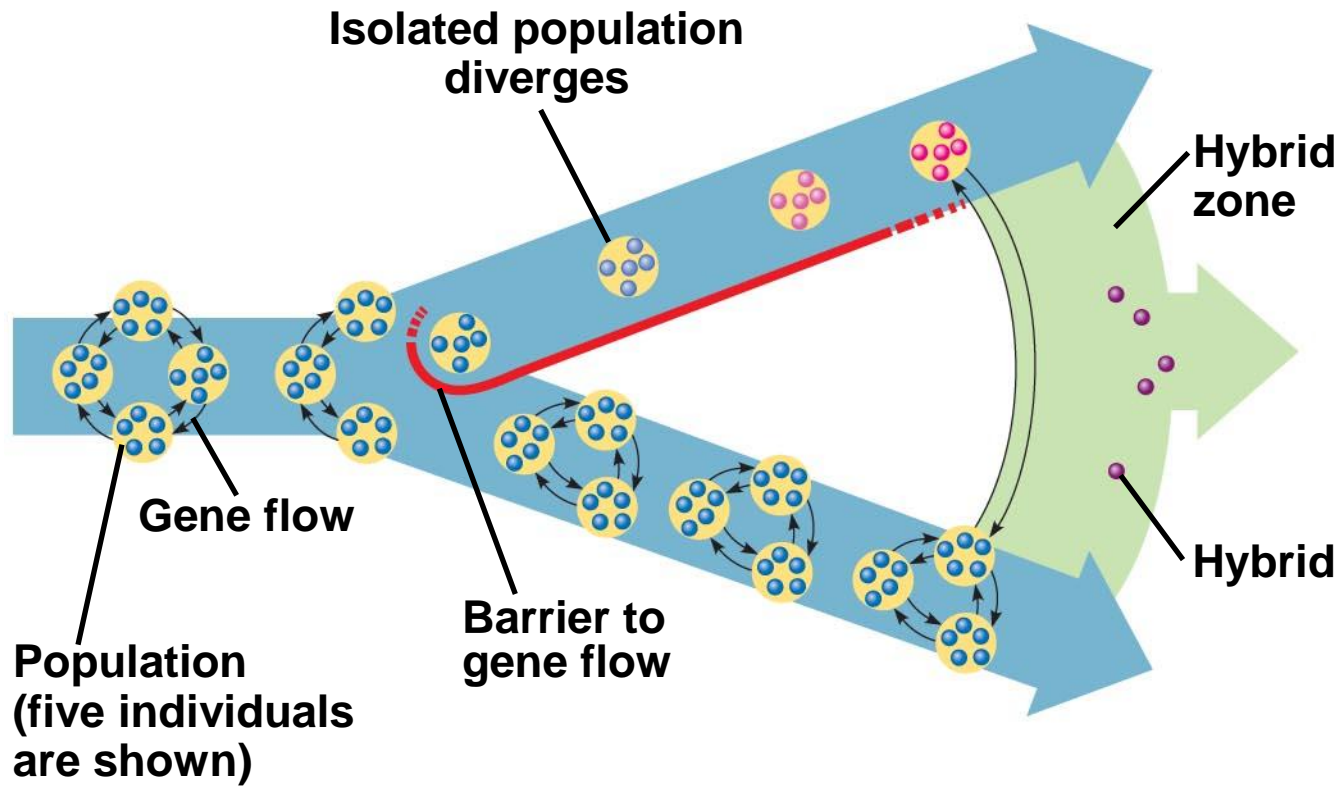
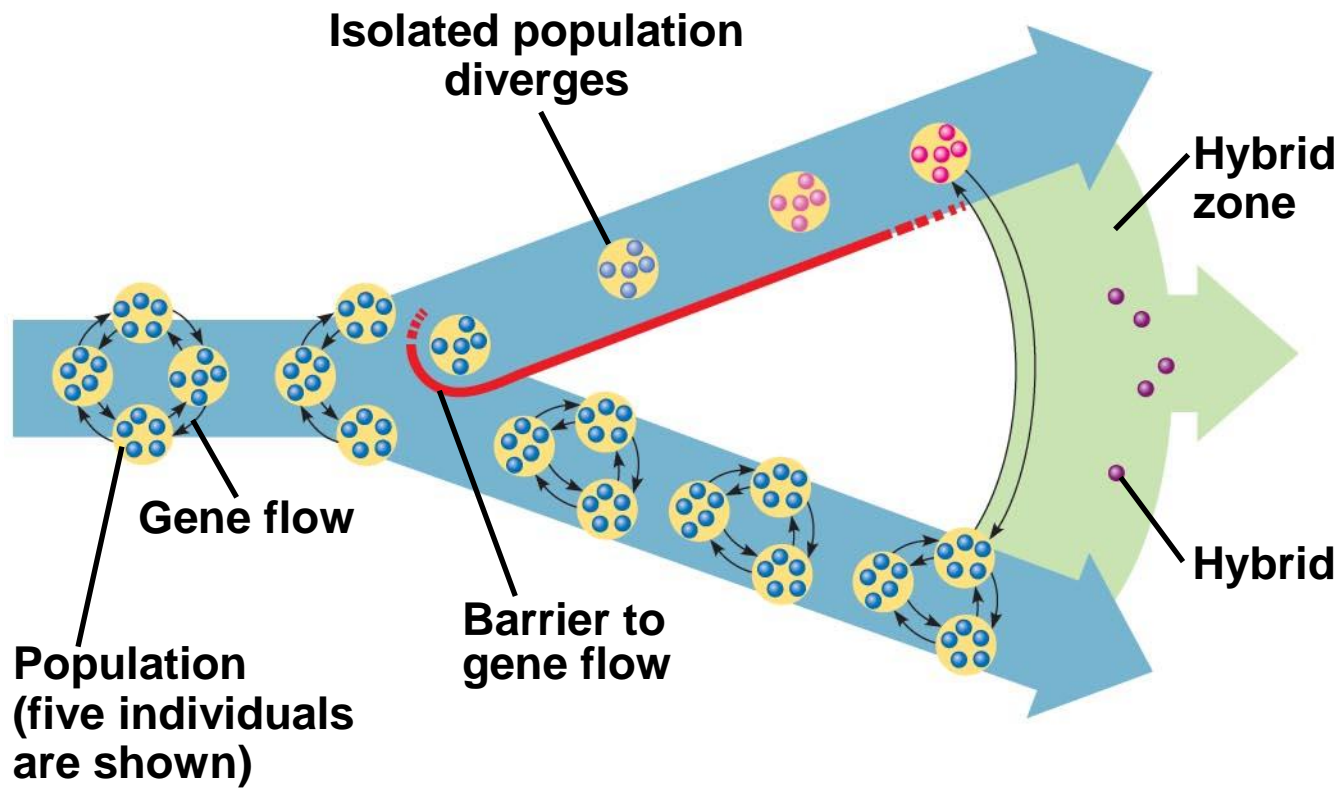
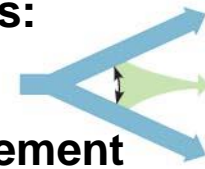


Fig. 24-14-4



Possible outcomes:

Reinforcement



OR

Fusion



OR

Stability

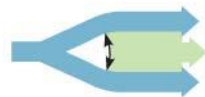


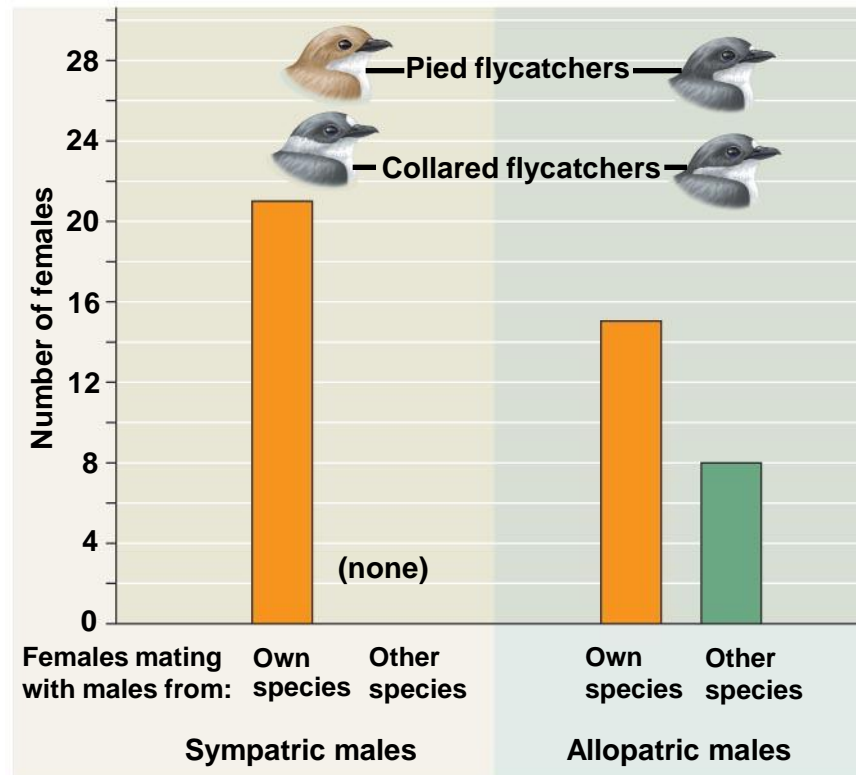
Fig. 24-15



Sympatric male  
pied flycatcher



Allopatric male  
pied flycatcher





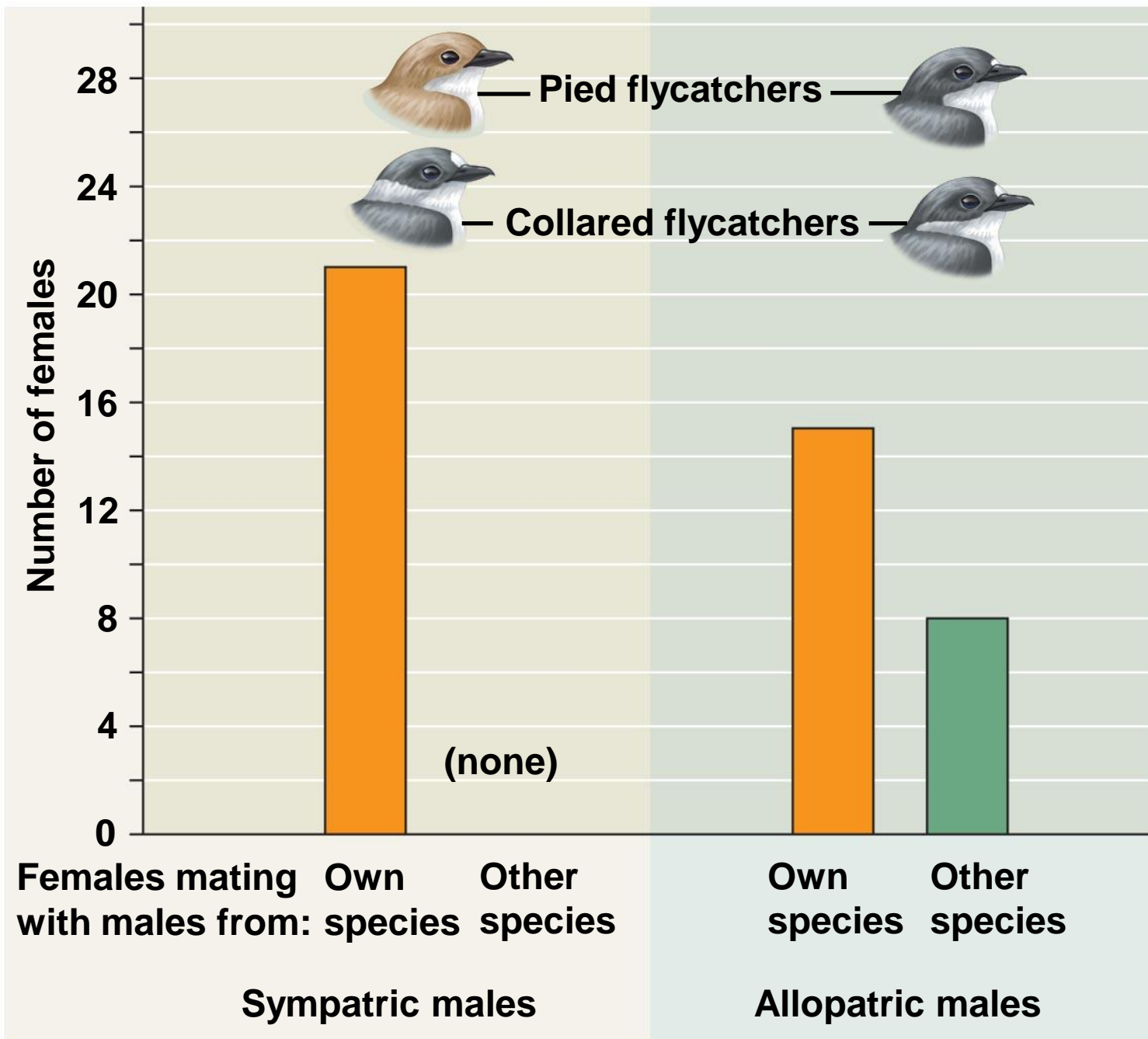
**Sympatric male  
pied flycatcher**

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**Allopatric male  
pied flycatcher**

Fig. 24-15b

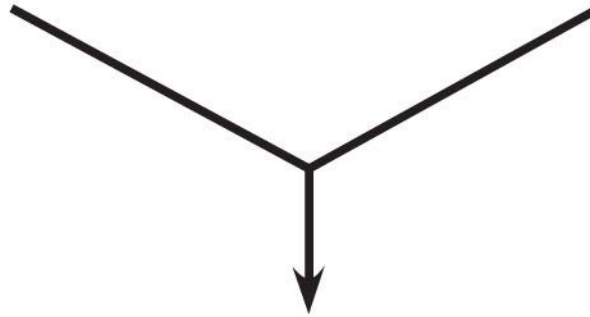




*Pundamilia nyererei*



*Pundamilia pundamilia*

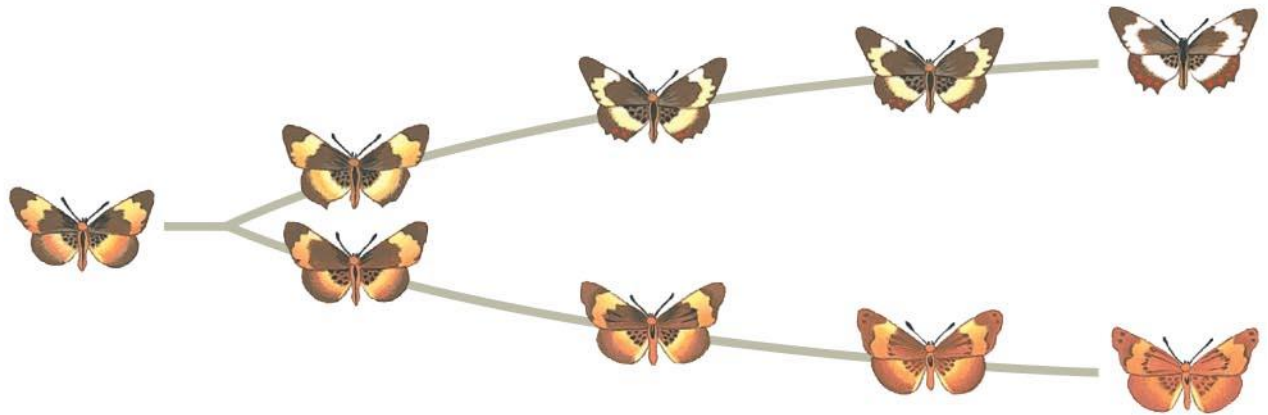


*Pundamilia* “turbid water,”  
hybrid offspring from a location  
with turbid water

**(a) Punctuated pattern**

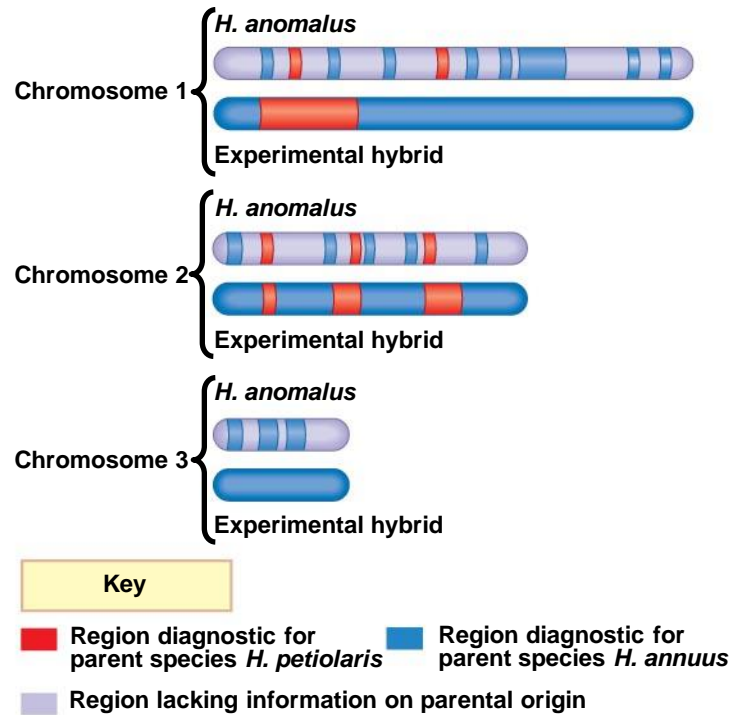


**(b) Gradual pattern**





(a) The wild sunflower *Helianthus anomalus*



(b) The genetic composition of three chromosomes in *H. anomalus* and in experimental hybrids

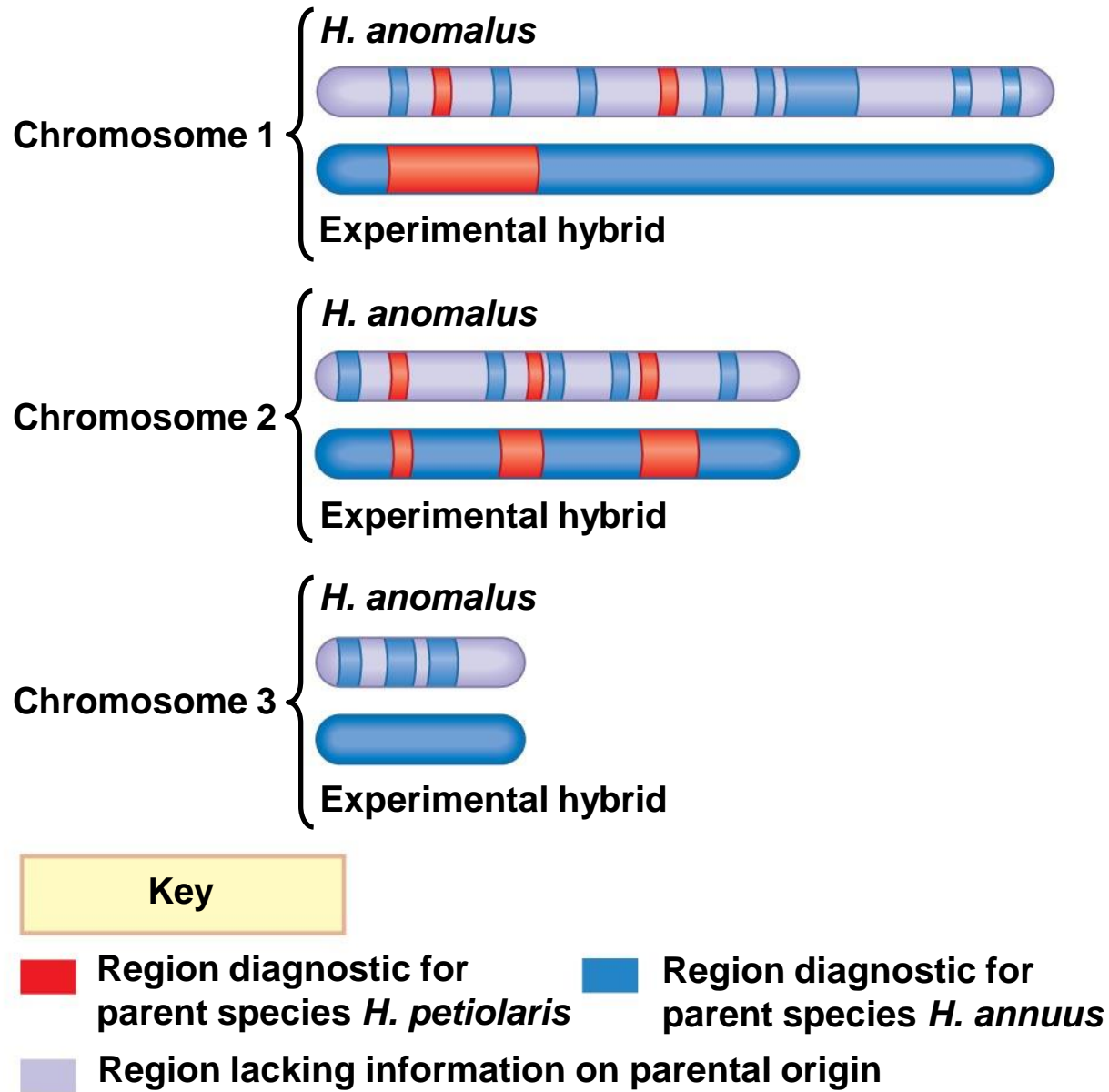


Fig. 24-18a



**(a) The wild sunflower *Helianthus anomalus***

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(b) The genetic composition of three chromosomes in *H. anomalus* and in experimental hybrids

Fig. 24-19





(a) Typical *Mimulus lewisii*



(b) *M. lewisii* with an *M. cardinalis* flower-color allele

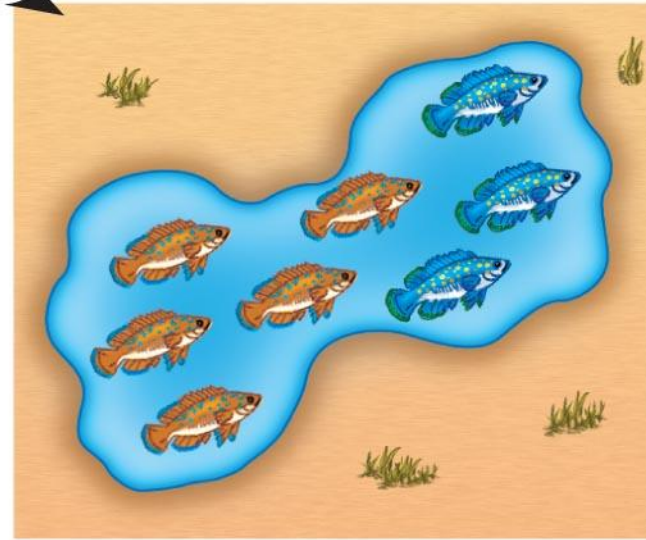
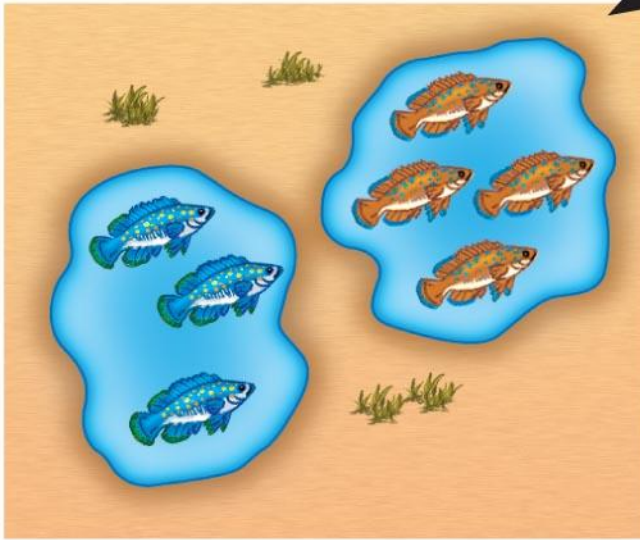
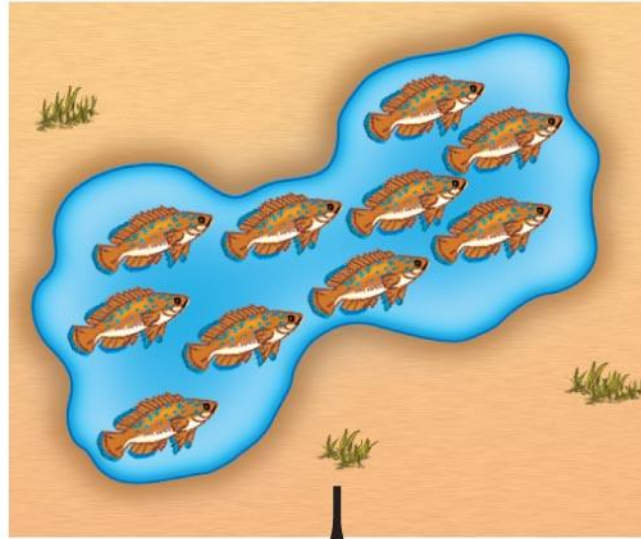


(c) Typical *Mimulus cardinalis*



(d) *M. cardinalis* with an *M. lewisii* flower-color allele

# Original population



**Allopatric speciation**

**Sympatric speciation**

## Ancestral species:



**AA**

***Triticum  
monococcum***  
**( $2n = 14$ )**



**BB**

**Wild  
*Triticum***  
**( $2n = 14$ )**



**DD**

**Wild  
*T. tauschii***  
**( $2n = 14$ )**

## Product:



**AA BB DD**

***T. aestivum***  
**(bread wheat)**  
**( $2n = 42$ )**

Fig. 24-UN3

