

Chapter 19

Evolution is Descent with Modification

“Nothing in Biology makes sense except in the light of evolution.”

- Theodosius Dobzhansky

Direct Evidence



Who influenced Mr. Verdi?
Ward, Lardell, Wenzel



Who influenced Mr. Darwin?

Lyell

Hutton

LaMarck

Cuvier

Malthus

Wallace?

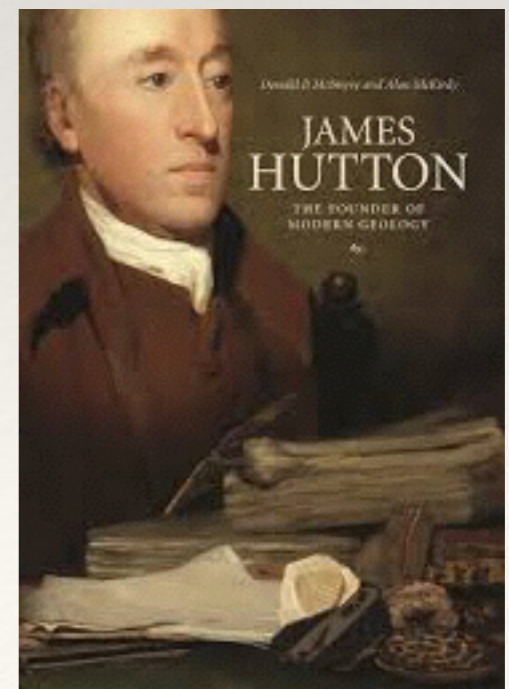


Figure 19.5

Darwin in 1840, after his return from the voyage



HMS Beagle at sea



8/19/15

1. Agenda:
2. Review and additions
3. Discuss reading
4. Lecture on Evidence
5. Pass out texts and demo eText

Learning Goal

Analyze the overwhelming amount of evidence that supports evolution.

5 postulates +...

- ❖ Evolution occurs as the unequal reproductive success of individuals ultimately leads to adaptations to their environment .
- ❖ Over time, natural selection can increase match between organisms and their environment.



(a) Cactus-eater



(c) Insect-eater



(b) Seed-eater

With your buddy, come up with a
definition of adaptation



(a) Cactus-eater

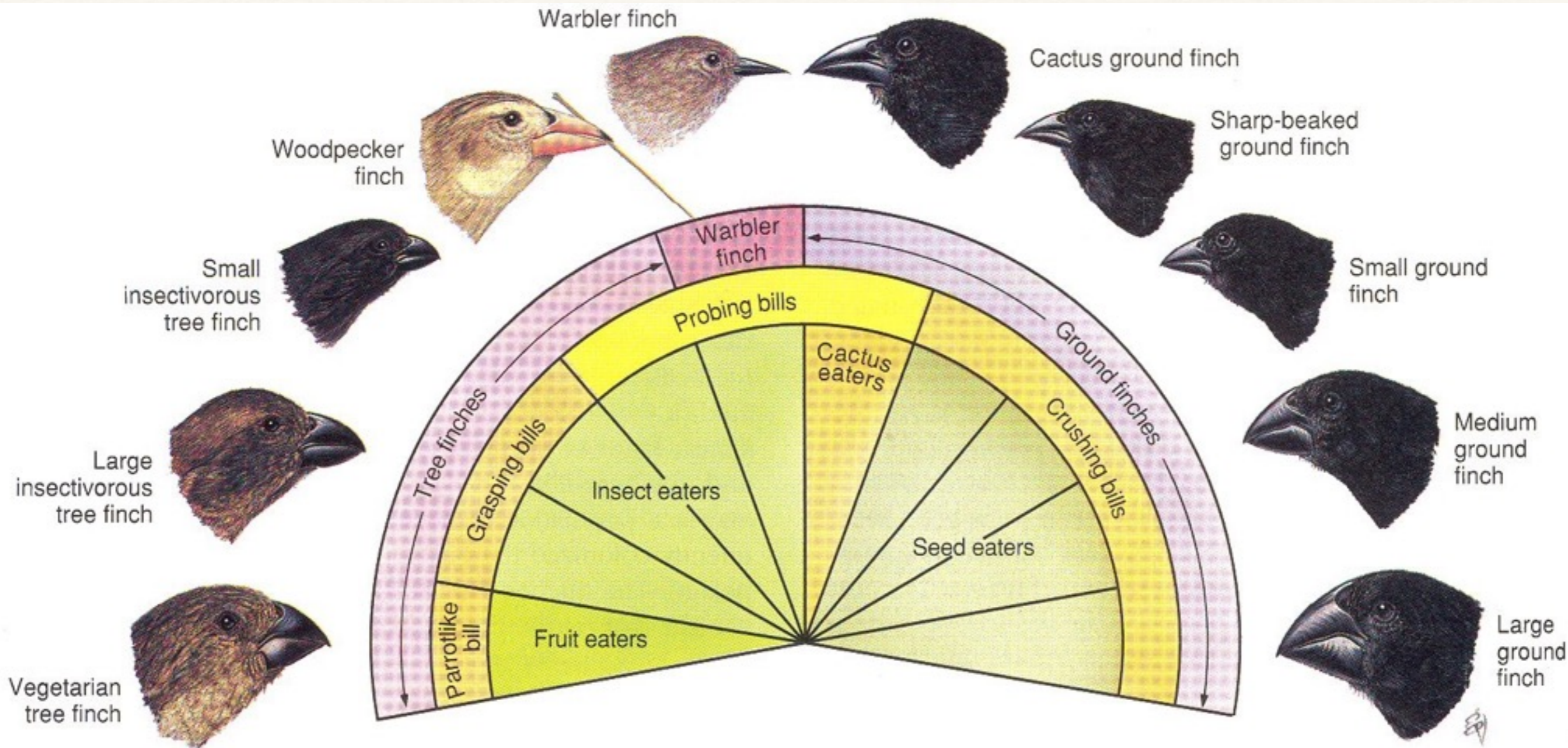


(b) Seed-eater



(c) Insect-eater

Adaptation



Adaptations - inherited characteristics of organisms that *enhance* their survival and reproduction in specific environments

On the Origin of Species by Means of Natural Selection

**Darwin perceived
adaptation to the
environment and the
origin of new species as
closely related processes**

“Thus, from the war of nature, from famine and death, the most exalted object of which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.”

Evidence that supports evolution

- ❖ Direct observation of evolution
- ❖ Homology
- ❖ Molecular Homologies
- ❖ Comparative Embryology
- ❖ Vestigial Structure
- ❖ Fossils
- ❖ Biogeography



Direct Evidence

- ❖ Watch Populations Evolve in our lifetime!

- ❖ Ones you know

- ❖ MRSA

- ❖ Flu Virus

- ❖ Finches

- ❖ From Text Soapberry

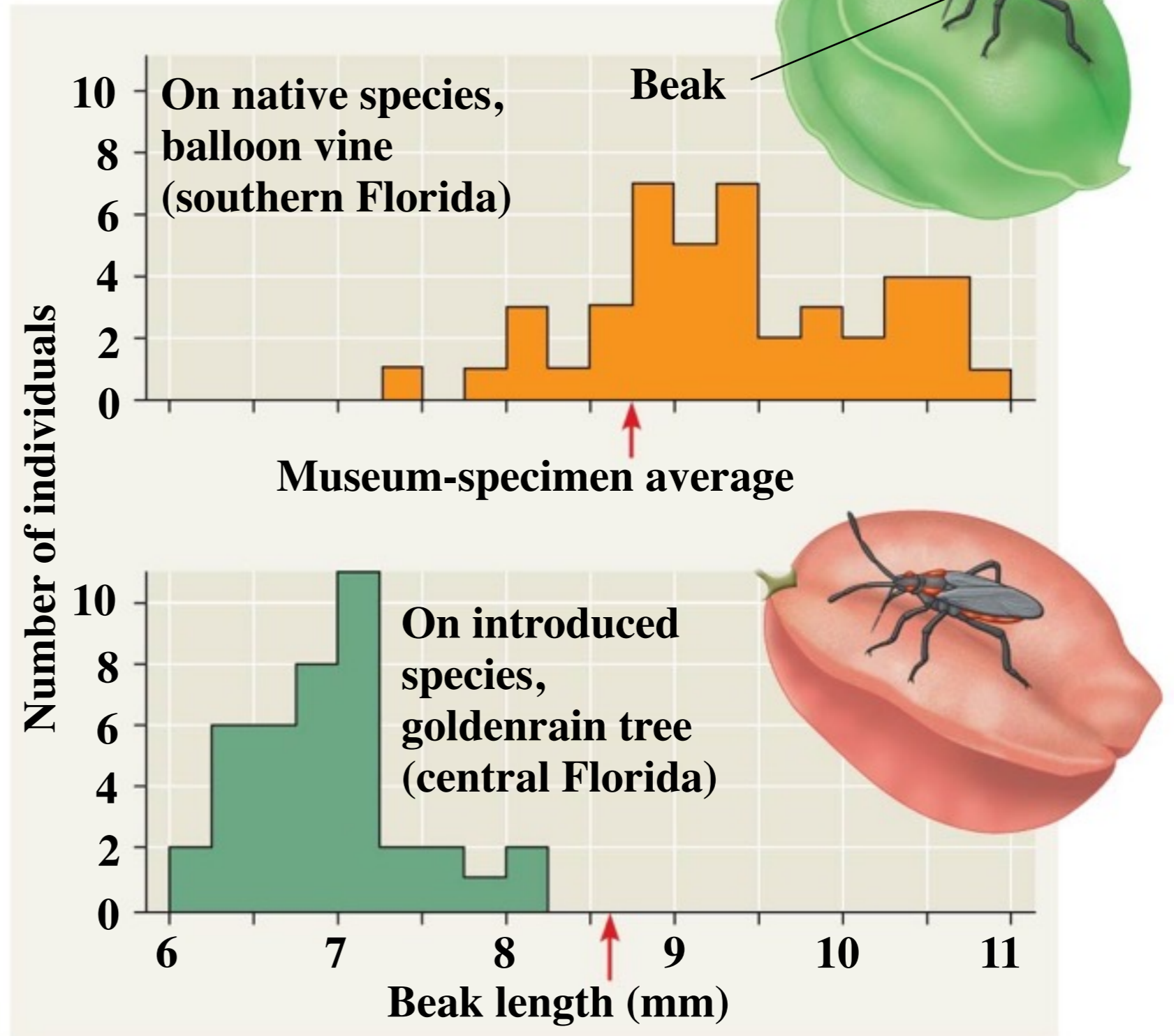
- ❖ Guppies

Field Study



Soapberry bug with beak inserted in balloon vine fruit

Results





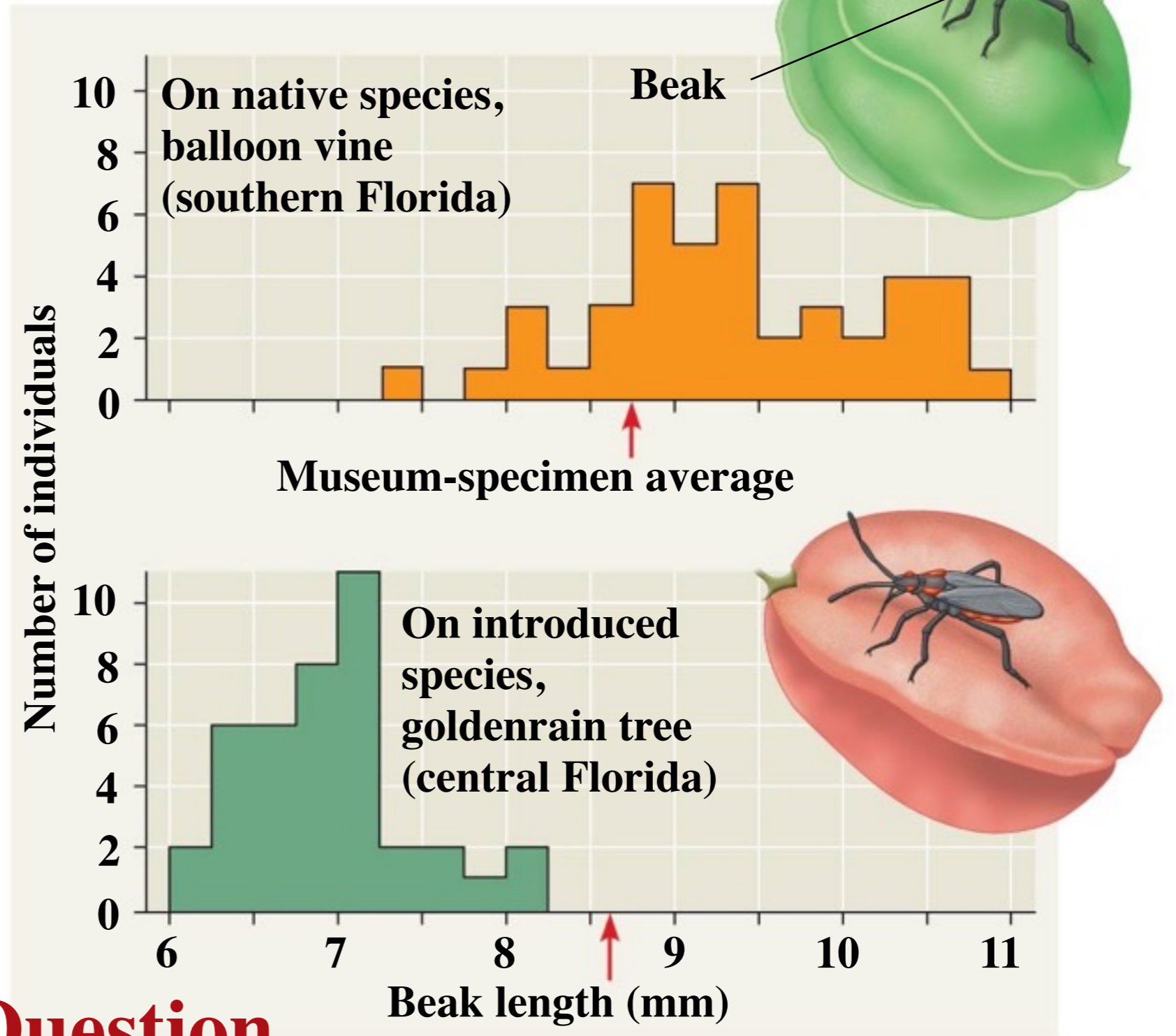


Field Study



Soapberry bug with beak inserted in balloon vine fruit

Results



Common Garden Question

Figure 19.15a

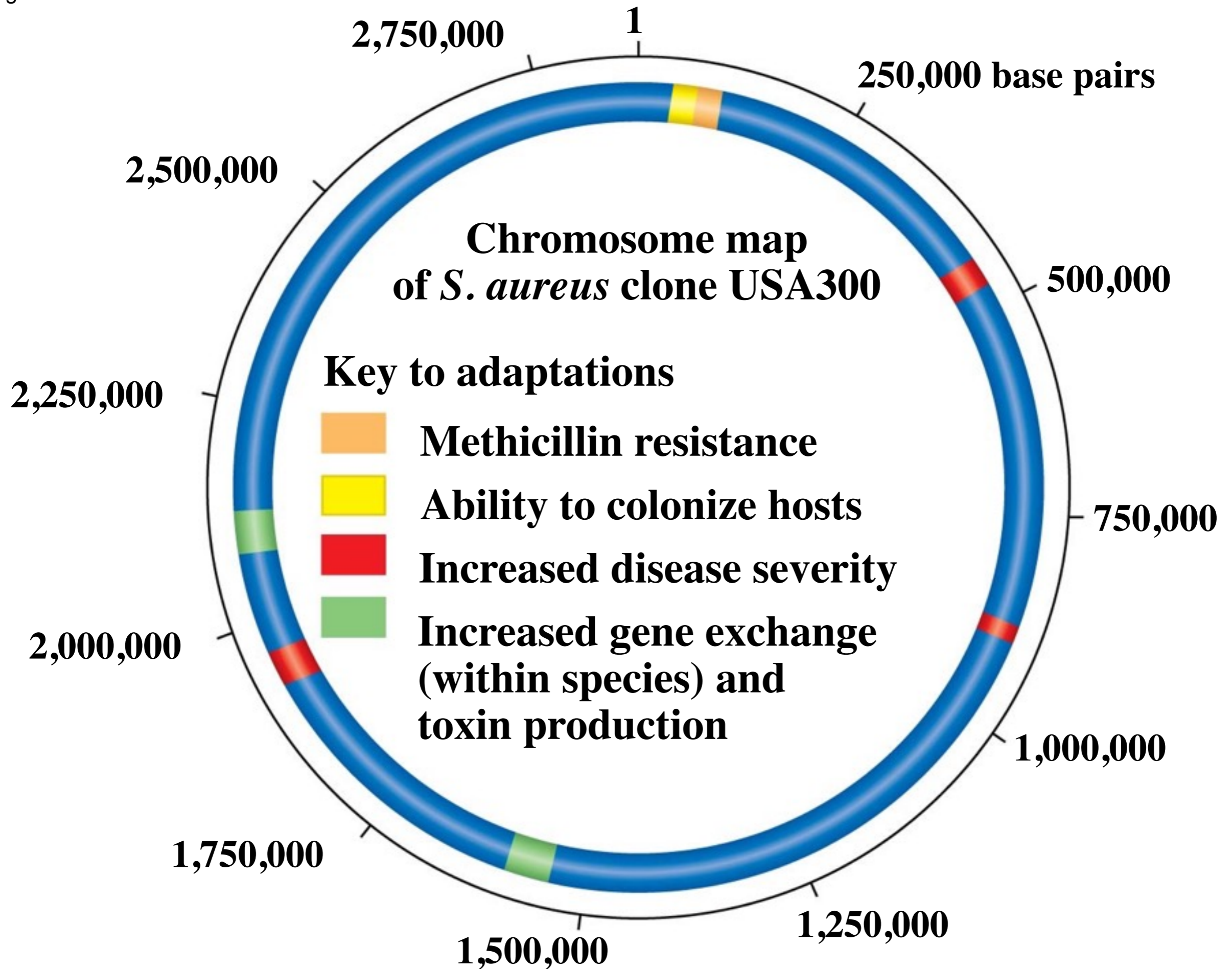
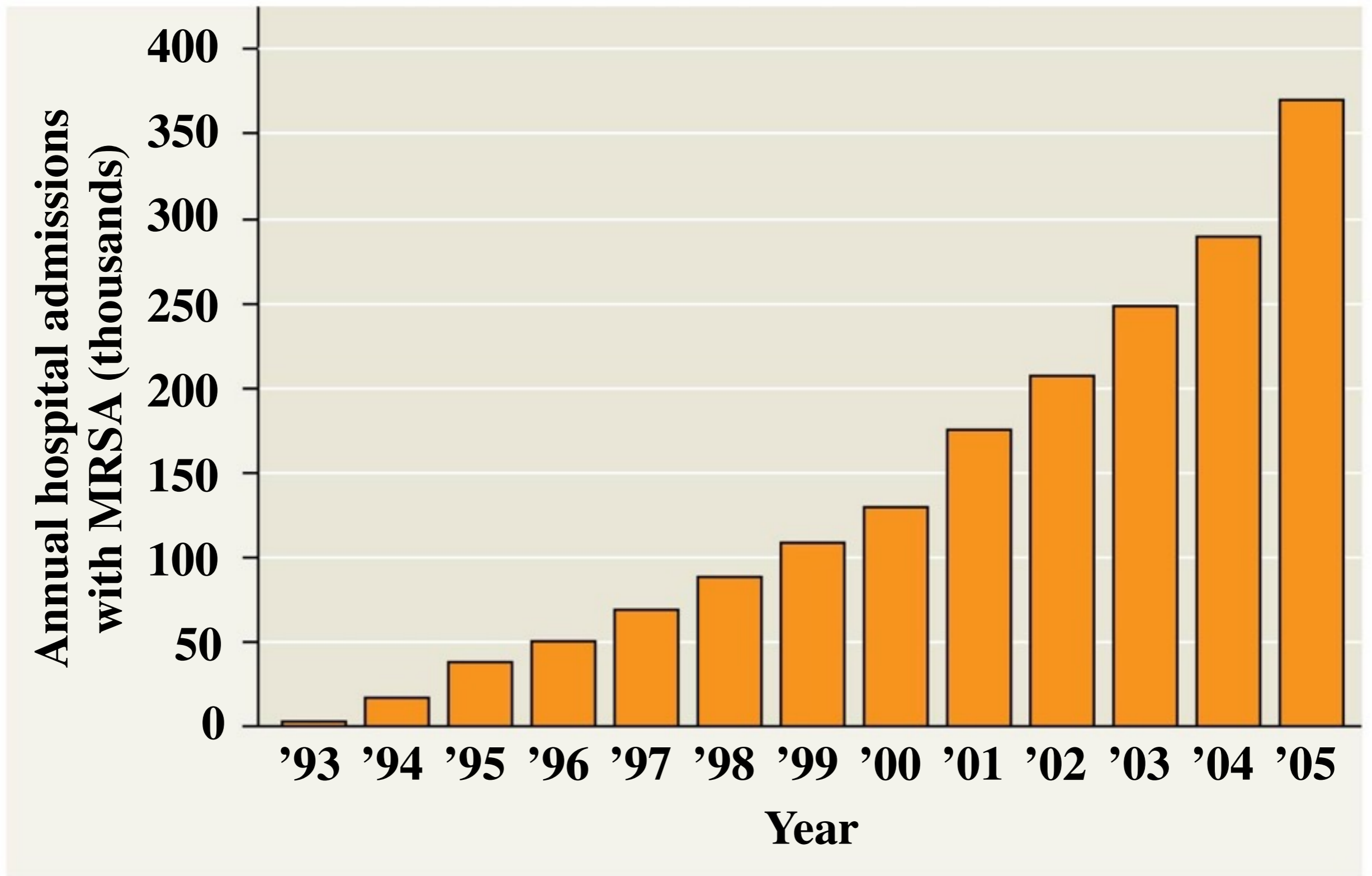
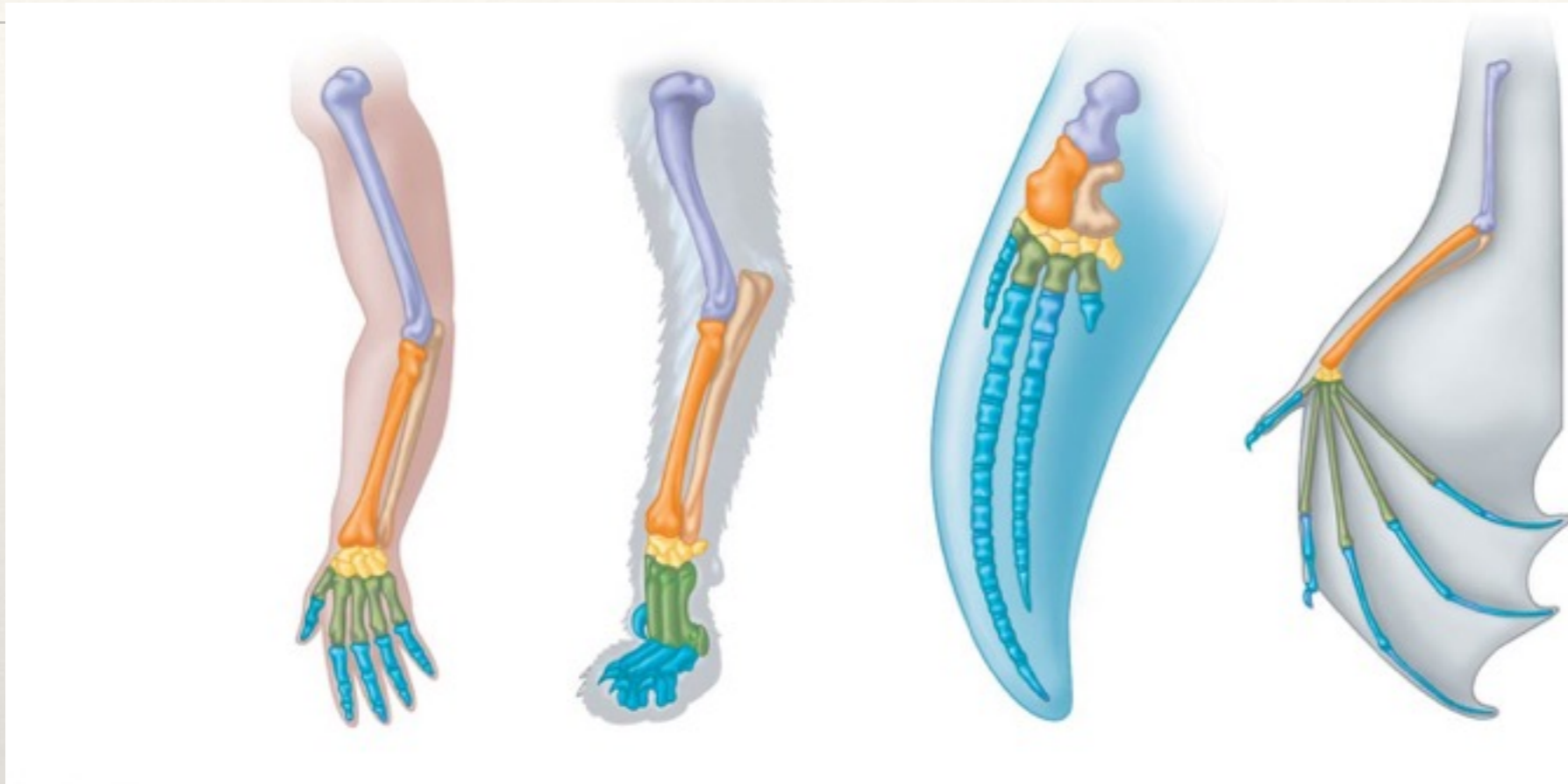


Figure 19.15b



Homology



❖ Homologies are similarity due to common ancestry

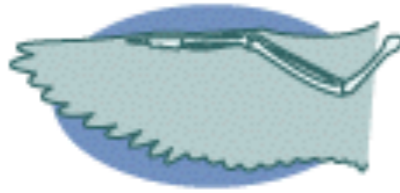
❖ Evolutionary theory predicts that related organisms will share similarities that are derived from common ancestors

Not homologous

Homologous

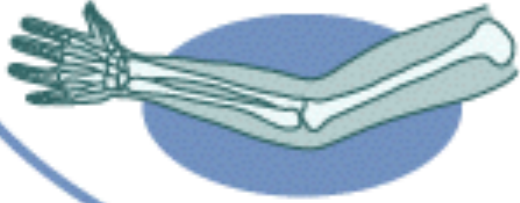
lizard

bird



human

whale



octopus



sea star



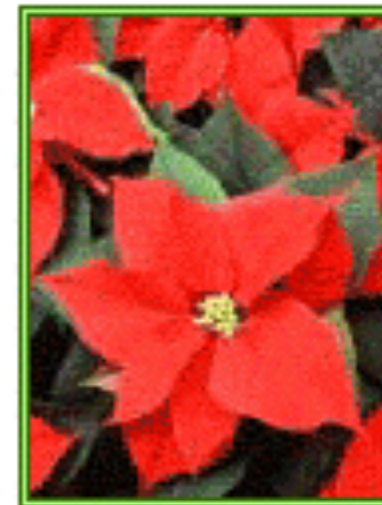
grasshopper



Pitcher Plant
leaves modified into pitchers to catch insects



Venus' Flytrap
leaves modified into jaws to catch insects



Poinsettia
bright red leaves resemble flower petals



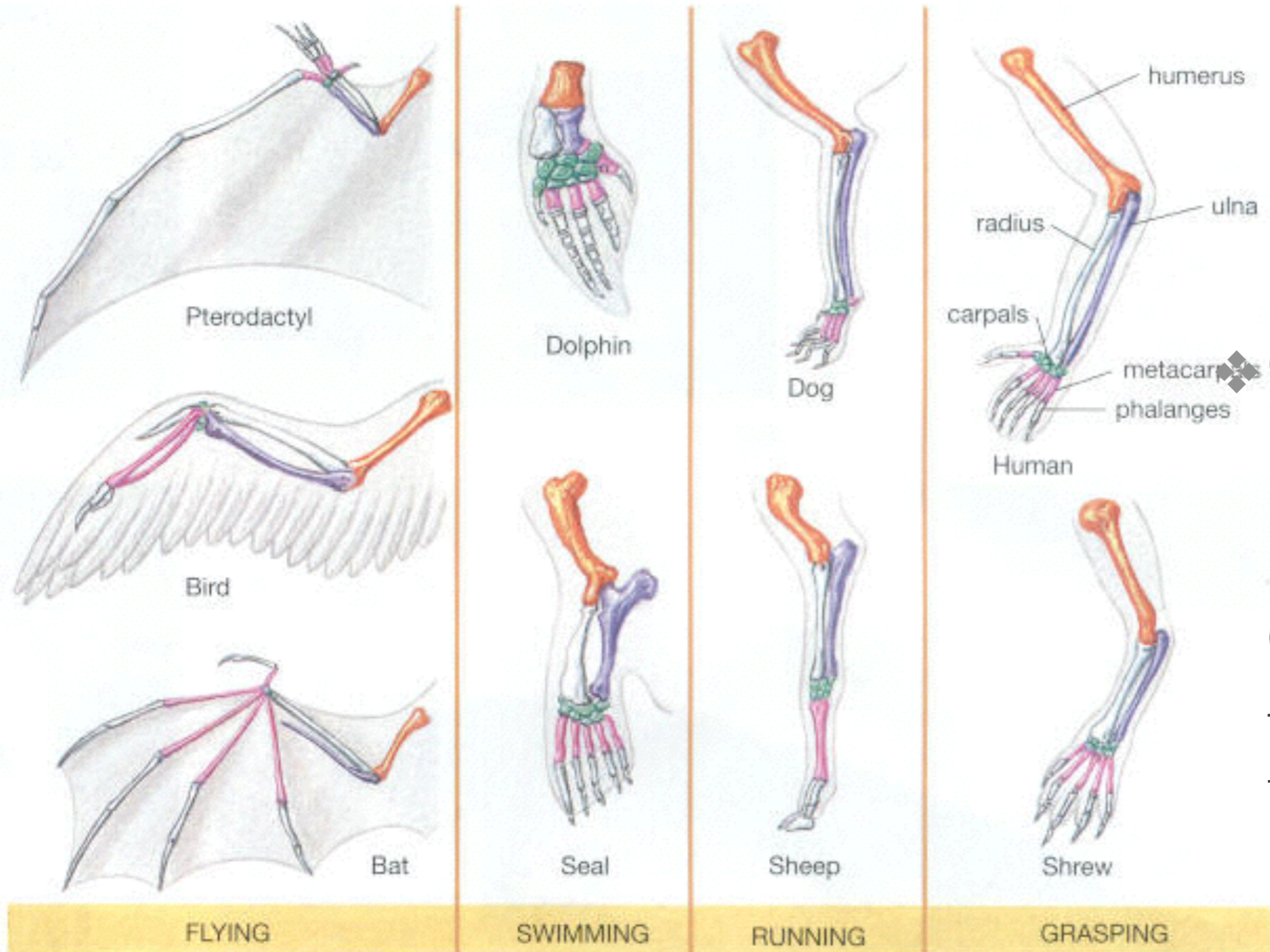
Cactus
leaves have become spines

Molecular Homology

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NM002255	MSPTVII LACLGFFLDQSVWAHVGGQDKPFCSAWPSAVVPQGGHVTLRCHYRRGFNI FTLYKKDGVVPELYNRIFWNSFLI SPVTPAHAGTYRCRGFHP	100
AF034771	MSPTVII LACLGFFLDQSVWAHVGGQDKPFCSAWPSAVVPQGGHVTLRCHYRRGFNI FTLYKKDGVVPELYNRIFWNSFLI SPVTPAHAGTYRCRGFHP	100
AF034772	MSPTVII LACLGFFLDQSVWAHVGGQDKPFCSAWPSAVVPQGGHVTLRCHYRRGFNI FTLYKKDGVVPELYNRIFWNSFLI SPVTPAHAGTYRCRGFHP	100
AF034773	MSPTVII LACLGFFLDQSVWAHVGGQDKPFCSAWPSAVVPQGGHVTLRCHYRRGFNI FTLYKKDGVVPELYNRIFWNSFLI SPVTPAHAGTYRCRGFHP	100
AF276292	MSPTVII LACLGFFLDQSVWAHVGGQDKPFCSAWPSAVVPQGGHVTLRCHYRRGFNI FTLYKKDGVVPELYNRIFWNSFLI SPVTPAHAGTYRCRGFHP	100
AF334644I LACLGFFLDQSVWAHVGGQDKPFCSAWPSAVVPQGGHVTLRCHYRRGFNI FTLYKEDGVVPELYKRIFWNSFLI SPVTAAHAGTYRCRVFHP	94
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AF034772	HSPTEWSAPSNPLVIMVTGLYEKPSLTARPGPTVRAGENVT LSCS SQSSFDI YHLSRDEGEAHELRLPAVPSI NGTFQADFF LGPATHGETYRCFGSFHGS	200
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AF361089	HSPTEWSAPSNPLVIMVTGLYEKPSLSAQPGPTVPTGENMT LSCS SRRSFIMYHLSRDEGEAHELRLPAVPSVNGTFQADFF LGPATHGGNYRCFGSLRDS	200
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NM002255	PYEWSDPSDPLPVSVTGNPSSSWPSPTEPSFKTGIARHLHAVIRYSVAII LFTILPFFLLHRWCSSKKK.....NAAVMNQEP A	278
AF034771	PYEWSDASDPLPVSVTGNPSSSWPSPTEPSFKTGIARHLHAVIRYSVAII LFTILPFFLLHRWCSSKKK.....NAAVMNQEP A	278
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AF034773	PYEWSDPSDPLPVSVTGNPSSSWPSPTEPSFKTGIARHLHAVIRYSVAII LFTILPFFLLHRWCSSKKK.....NAAVMNQEP A	278
AF276292	PYEWSDPSDPLPVSVTGNPSSSWPSPTEPSFKTGIARHLHAVIRYSVAII LFTILPFFLLHRWCSSKKK.....NLL.....	271
AF334644	PYEWSDPSDPLPVSVTGNPSSSWPSPTEPSFKTGI VTHLPAVIRYSVATIFL TILLFFLLHRCWCSSDKK.....NAAVMDPEP A	272
AF361089	PYEWSDPSDPLPVSVTGNPSSSWPSPTEPSFKTGI VTHLPAVIRYSVATIFL TILLFFLLHRCWCSSDKK.....NAAVMDPEP A	278
NK92-KIR	GHR7VNRNREDSDEQDPQEVTYAQLDHCIF TQRKITGFSQRSKRP ST DTSVCIELPNAEPRALSPAHEHHSQALMGSSRETTALSQTQLASSNVPAAG	396
NM002255	GHR7VNRNREDSDEQDPQEVTYAQLDHCIF TQRKITGFSQRSKRP ST DTSVCIELPNAEPRALSPAHEHHSQALMGSSRETTALSQTQLASSNVPAAG	374
AF034771	GHR7VNRNREDSDEQDPQEVTYAQLDHCIF TQRKITGFSQRSKRP ST DTSVCIELPNAEPRALSPAHEHHSQALMGSSRETTALSQTQLASSNVPAAG	374
AF034772	GHR7VNRNREDSDEQDPQEVTYAQLDHCIF TQRKITGFSQRSKRP ST DTSVCIELPNAEPRALSPAHEHHSQALMGSSRETTALSQTQLASSNVPAAG	374
AF034773	GHR7VNRNREDSDEQDPQEVTYAQLDHCIF TQRKITGFSQRSKRP ST DTSVCIELPNAEPRALSPAHEHHSQALMGSSRETTALSQTQLASSNVPAAG	374
AF276292	271
AF334644	GDR7VNRNREDFDEQDPQEVTYTQLDHCVF TRGKITRFSQRKPTFP T DTSVYIELPNAEPRLLSPAHEHHRQAWKSSMETTALSQNRLHSSNVPAVG	368
AF361089	GDR7VNRNREDFDEQDPQEVTYTQLDHCVF TRGKITRFSQRKPTFP T DTSVYIELPNAEPRLLSPAHEHHRQAWKSSMETTALSQNRLHSSNVPAVG	374

<http://www.protein.bio.msu.ru/biokhimiya/contents/v71/full/71S10060.html>

Careful!



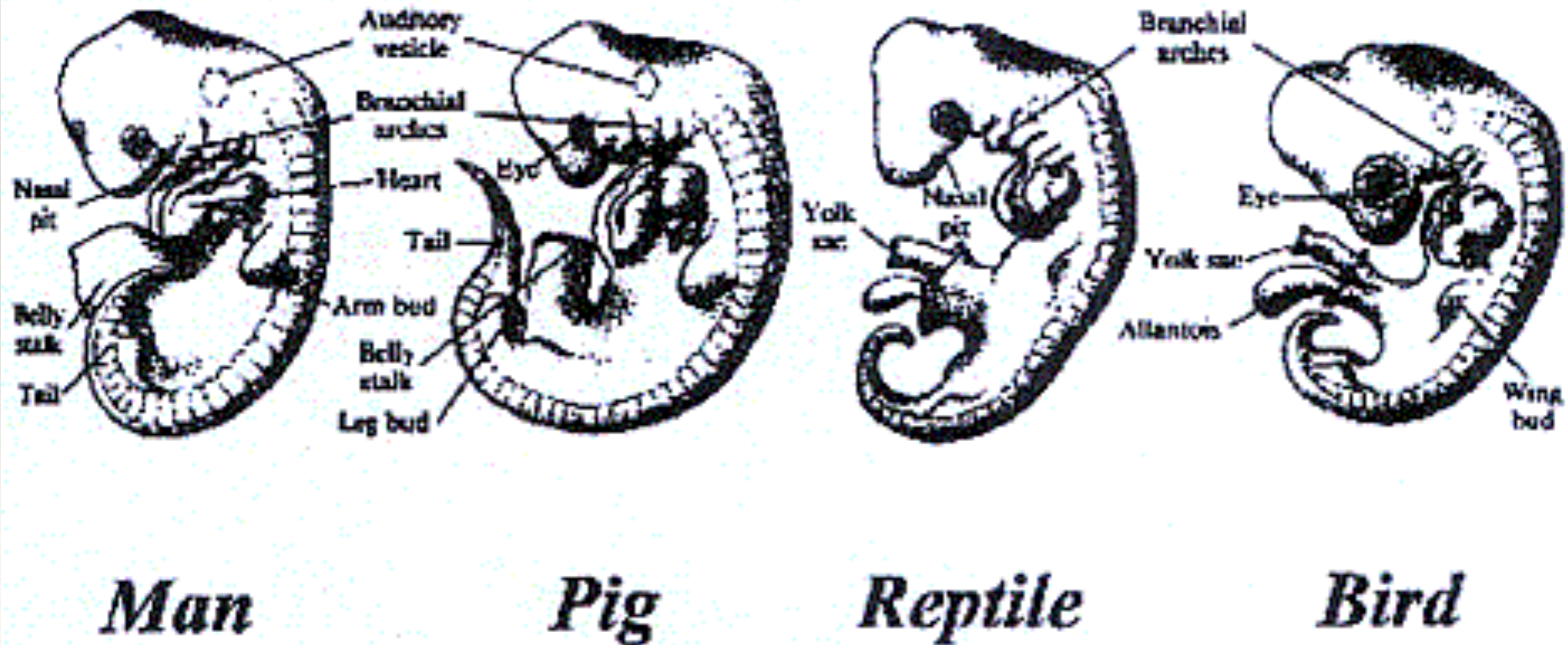
Similarity does not equate to homology

Comparitive Embryology

❖ ORP is bunk!

❖ ORP is bunk!

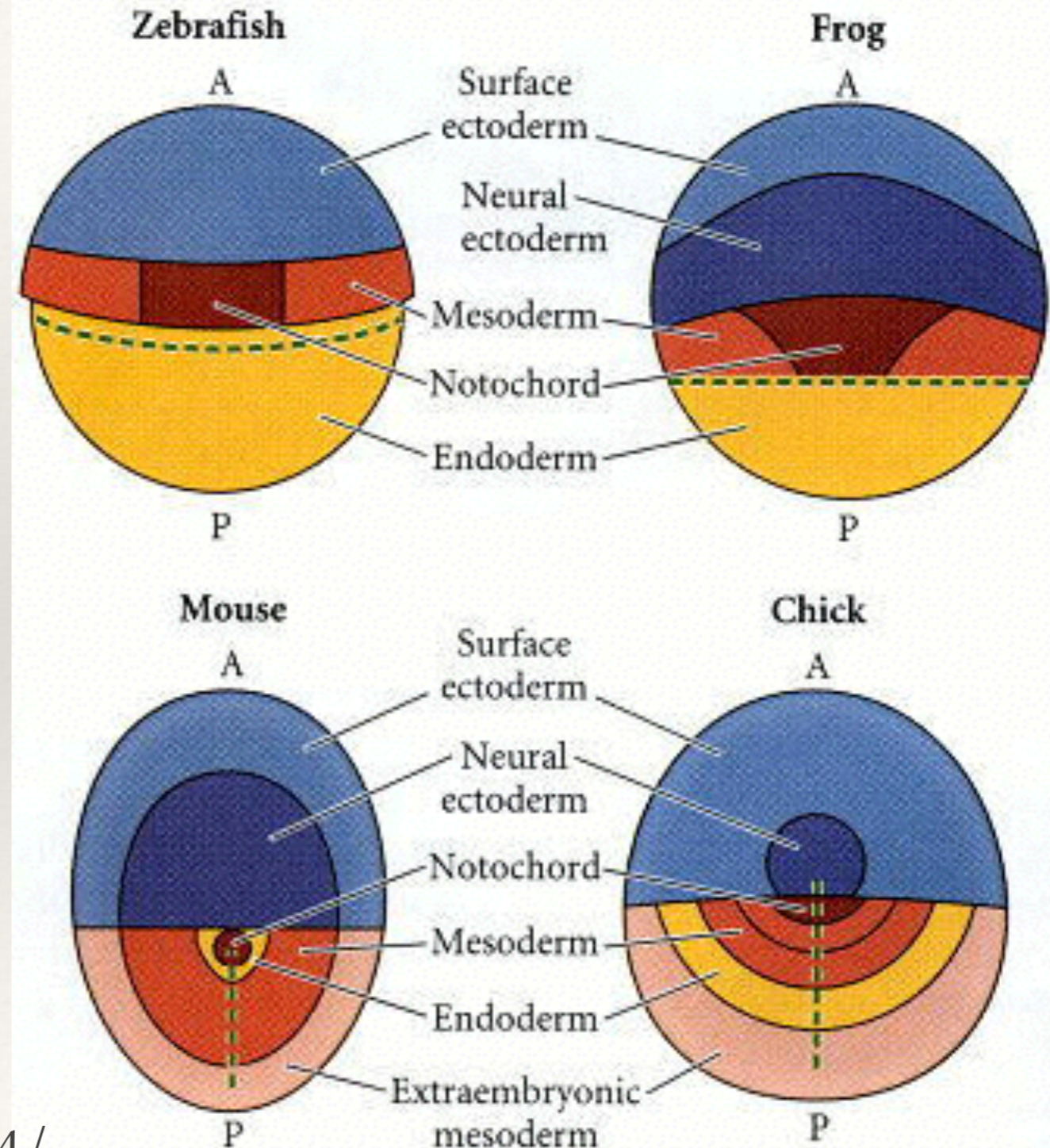
Figure 2: Homologous Similarity Among Vertebrate Embryos



Fate Mapping the Embryo

One of the most important programs of descriptive embryology became the tracing of **cell lineages**: following individual cells to see what they become

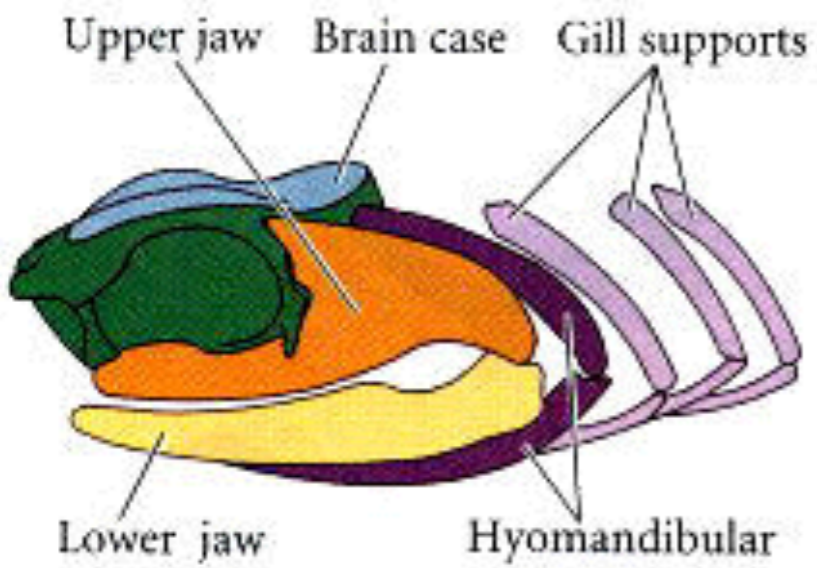
Fate maps of different vertebrate classes at the early gastrula stage



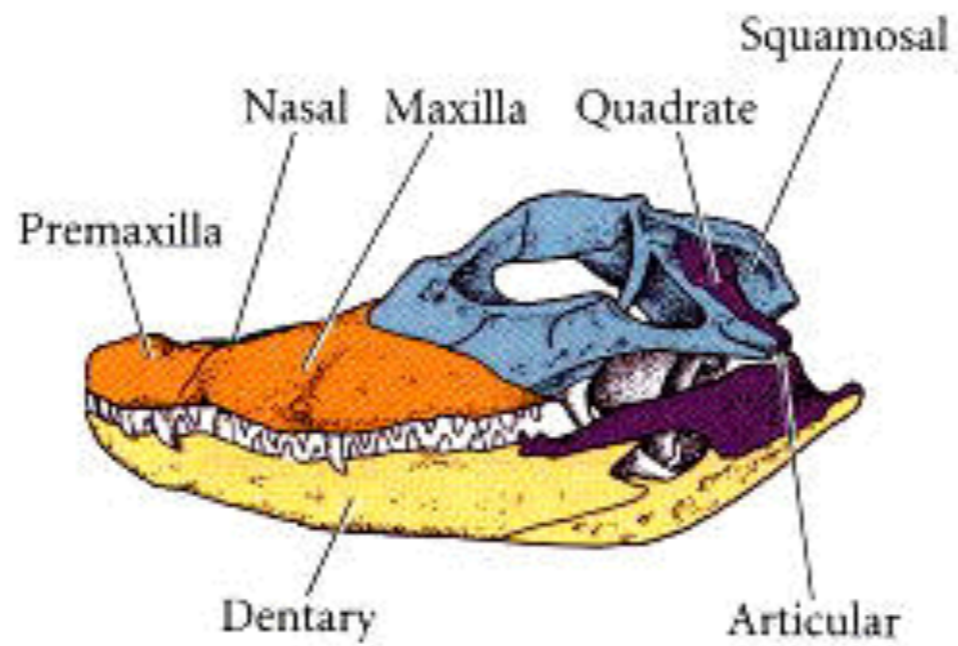
Ambystoma mexicanum
gill arches (ectoderm removed)



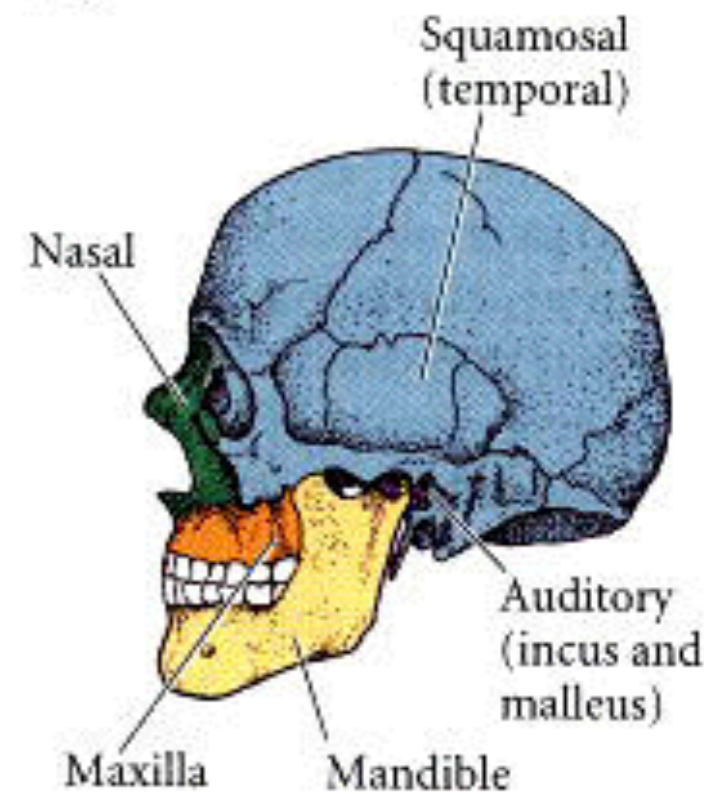
(A)



(B)



(C)



Developmental Biology. 6th edition.
Gilbert SF.
Sunderland (MA): [Sinauer Associates](http://www.wiley.com); 2000.

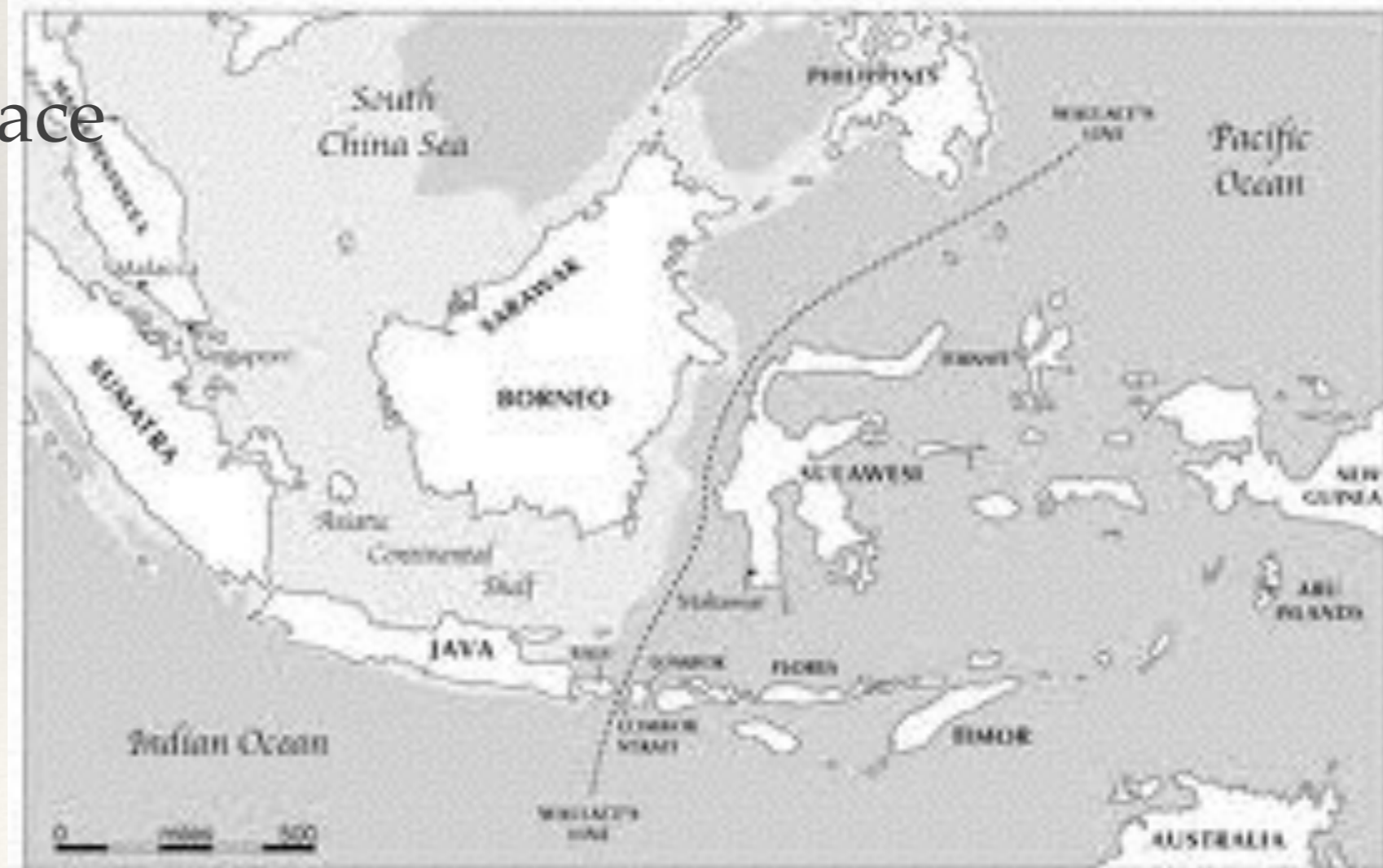
Fossils

- ❖ Found fossils of animals that definitely did not exist today
- ❖ But they closely resembled living things on the planet (hugeeeeeeeee armadillos)



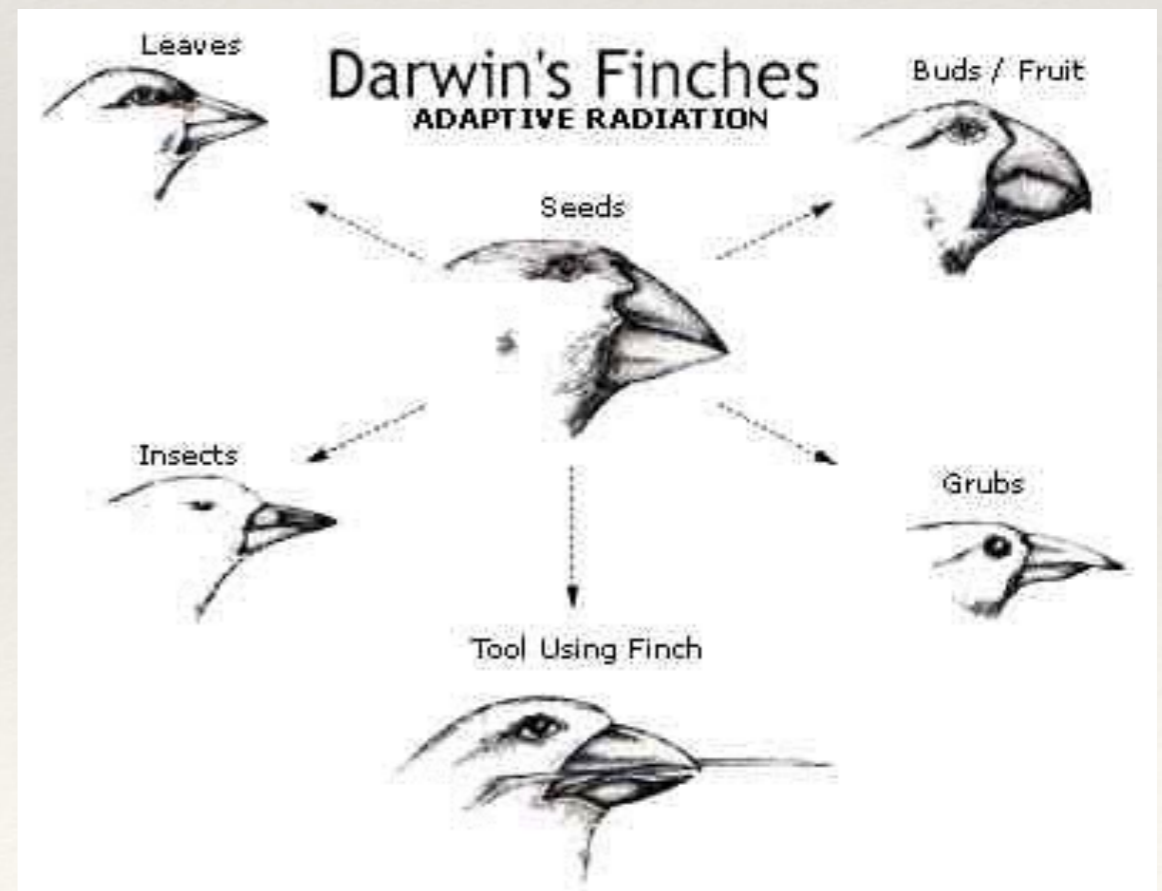
Biogeography

- ❖ From island to island and mainland to mainland, species were slightly different from each other
- ❖ Alfred Russel Wallace



Biogeography

- ❖ Study of range of animals and plants in different places
- ❖ When forms are related, evolve in one location and spread



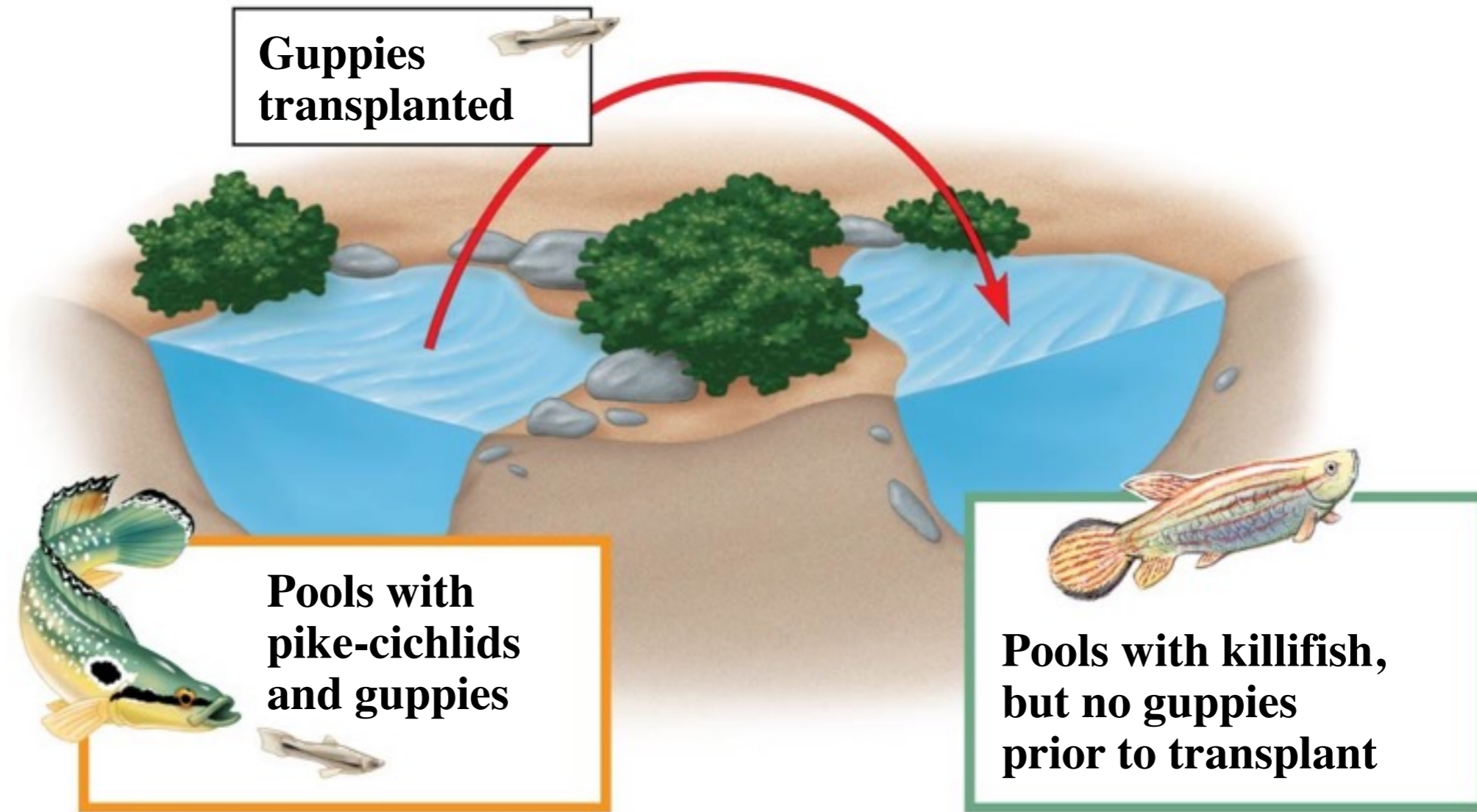
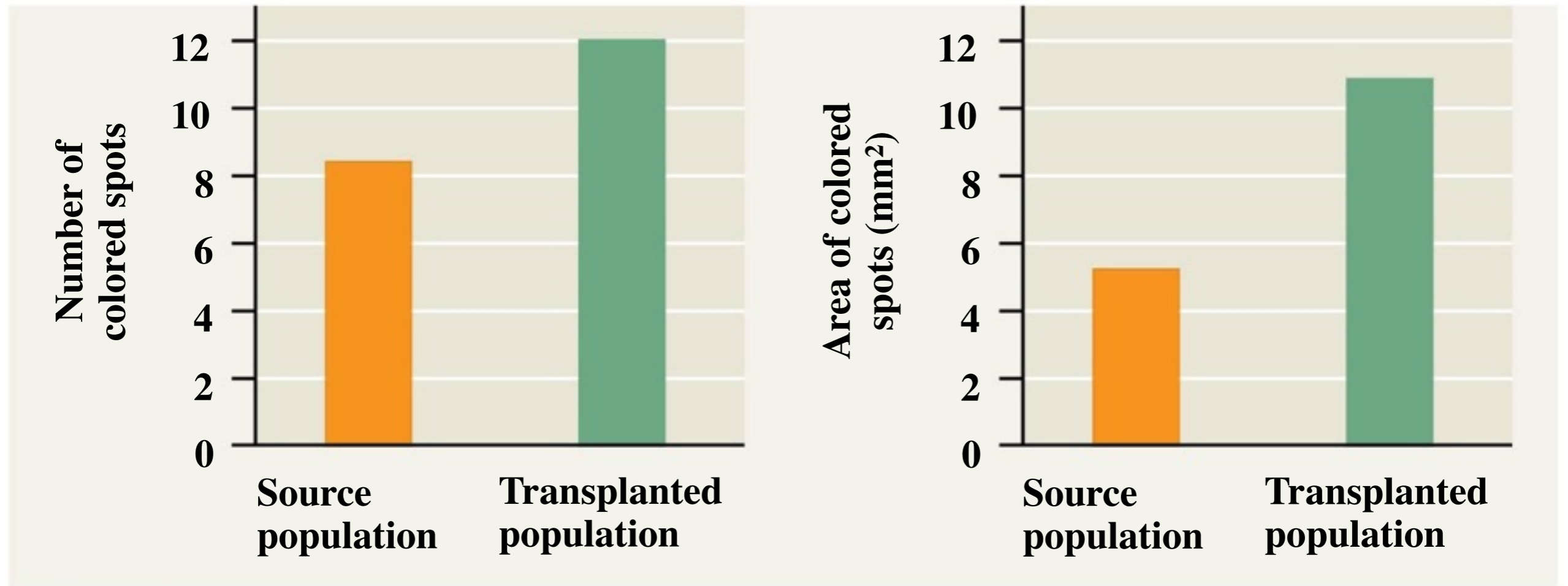


Figure 19.UN02b



Observations

Individuals in a population vary in their heritable characteristics.

Organisms produce more offspring than the environment can support.



Inferences

Individuals that are well suited to their environment tend to leave more offspring than other individuals.

and

Over time, favorable traits accumulate in the population.

Month	0	8	12
Mosquitoes Resistant* to DDT	4%	45%	77%

Source C. F. Curtis et al., Selection for and against insecticide resistance and possible methods of inhibiting the evolution of resistance in mosquitoes, *Ecological Entomology* 3:273–287 (1978).

*Mosquitoes were considered resistant if they were not killed within 1 hour of receiving a dose of 4% DDT.