

1. Based on the characters and frog pictures, Complete the **character matrix** below. In each box indicate whether the species has the trait (yes/no).

Character	Outgroup	A	B	C	D	E	F
Claws	No	Yes	Yes	Yes	Yes	No	Yes
Chin scales	No	Yes	Yes	Yes	Yes	No	Yes
Horn	No	No	Yes	No	Yes	No	Yes
Tail	No	Yes	Yes	Yes	Yes	Yes	Yes
Spikes	No	No	Yes	No	Yes	No	No
4 front digits	Yes	Yes	No	Yes	No	Yes	Yes
Spots	No	No	Yes	No	No	Yes	No
Tympanum ¹	Yes	No	Yes	No	Yes	Yes	Yes
Lateral Fold ²	No	Yes	Yes	Yes	No	Yes	Yes
Nostril	Yes	No	Yes	No	Yes	Yes	Yes
Total No. Derived Traits		4	8	4	6	3	5

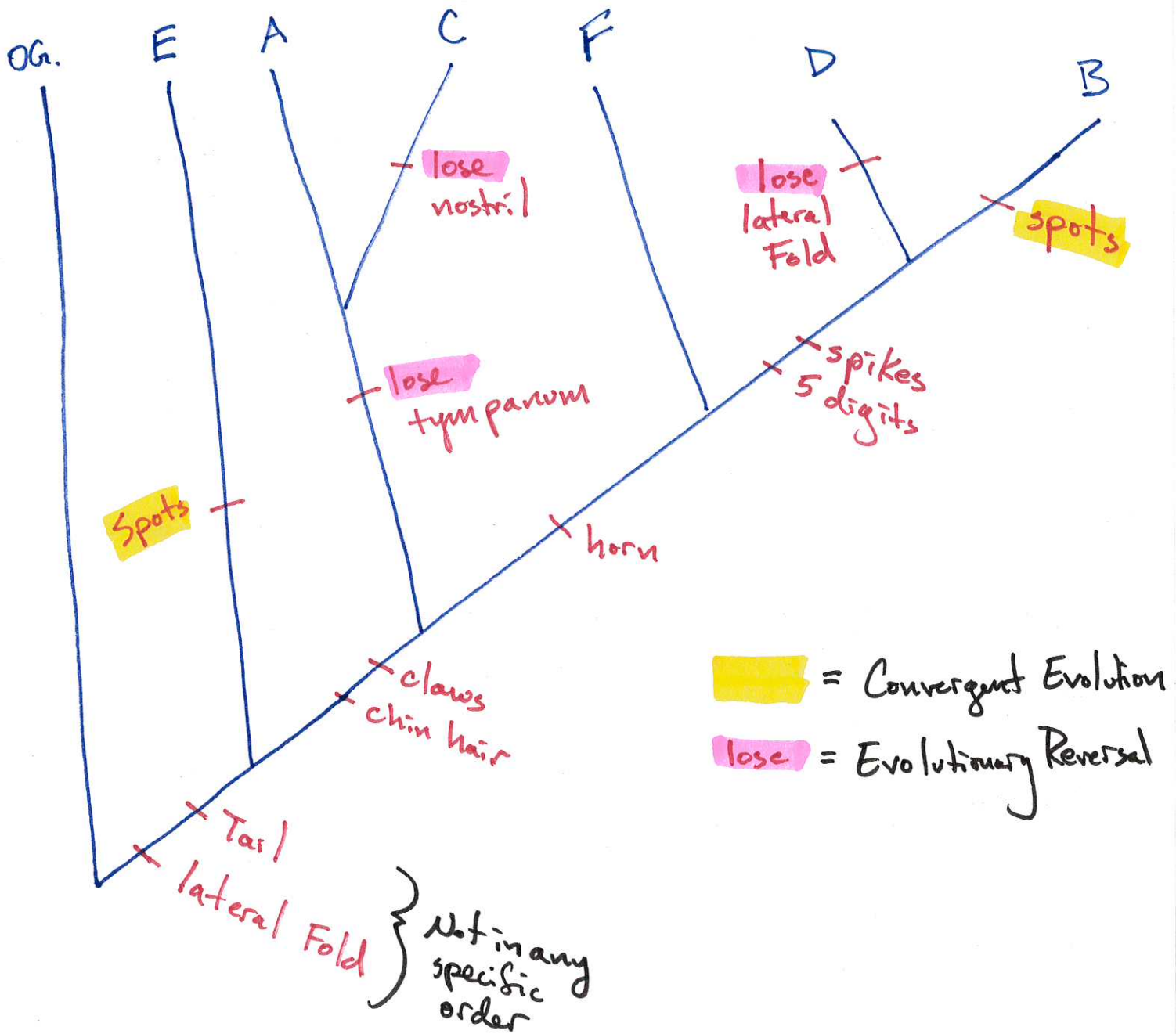
¹ a hearing organ/gland in frogs and toads, a flat red oval on both sides of a frog's head

² groove along the side of body

2. Determine which states are ancestral and derived based on the outgroup.
- Circle the derived traits** and write the total number of derived traits for each species in the boxes at the bottom of the table.
 - The species that is most closely related to the outgroup will have the fewest number of derived traits, while the species most distantly related to the outgroup will have the largest number of derived traits.
3. Fill out the following table indicating how many **derived traits** are shared for each species pair – i.e. those that **the outgroup doesn't have**. Just fill in the white boxes (the gray boxes are redundant). For example A and B share claws, chin scales, lateral fold, and a tail.

Species	A	B	C	D	E	F
A		4	4	3	2	4
B			4	6	3	5
C				3	2	4
D					1	4
E						2
F						

Phylogenetic Tree



- 12 Total Evolutionary Events
- 1 Convergent Evolution = Spots
- 2 Evolutionary Reversals = Nostril + tympanum