



HERPETOLOGIA

Aguilar Miguel X. 2018



*UNIVERSIDAD AUTÓNOMA DEL ESTADO DE
MÉXICO*

FACULTAD DE CIENCIAS

LICENCIATURA EN BIOLOGÍA

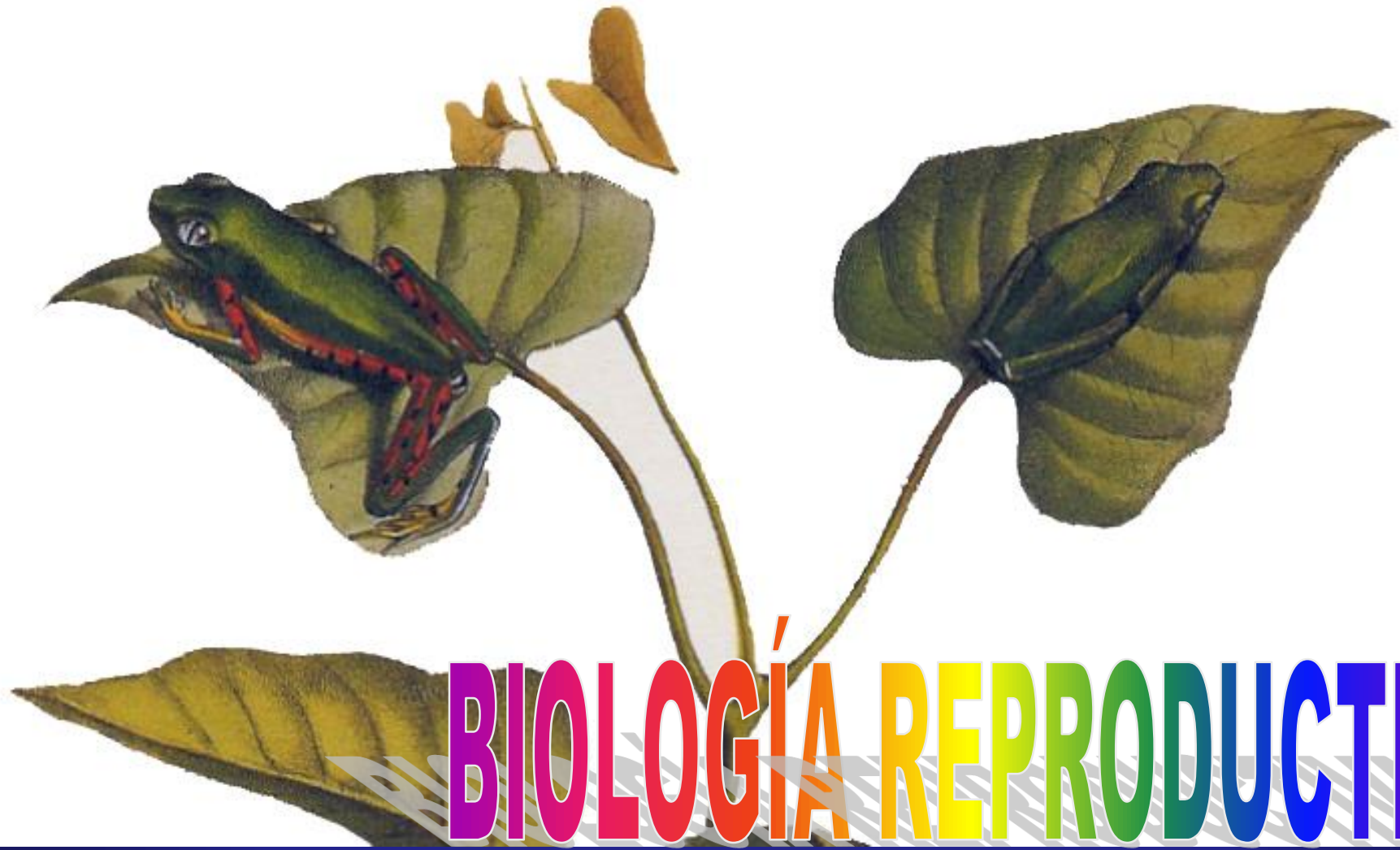
**MATERIAL DIDÁCTICO
VISIÓN**

**UNIDAD DE APRENDIZAJE
HERPETOLOGÍA**

UNIDAD III. PARTE 1

M. en C. Xóchitl Aguilar Miguel

Agosto - 2018



BIOLOGÍA REPRODUCTIVA DE ANFIBIOS



REPRODUCCIÓN SEXUAL VS ASESEXUAL

- **SEXUAL**

- ❖ GAMETO MASCULINO + GAMETO FEMENINO = CIGOTO
- ❖ MEIOSIS- RECOMBINACIÓN DE GAMETOS

- **ASESEXUAL**

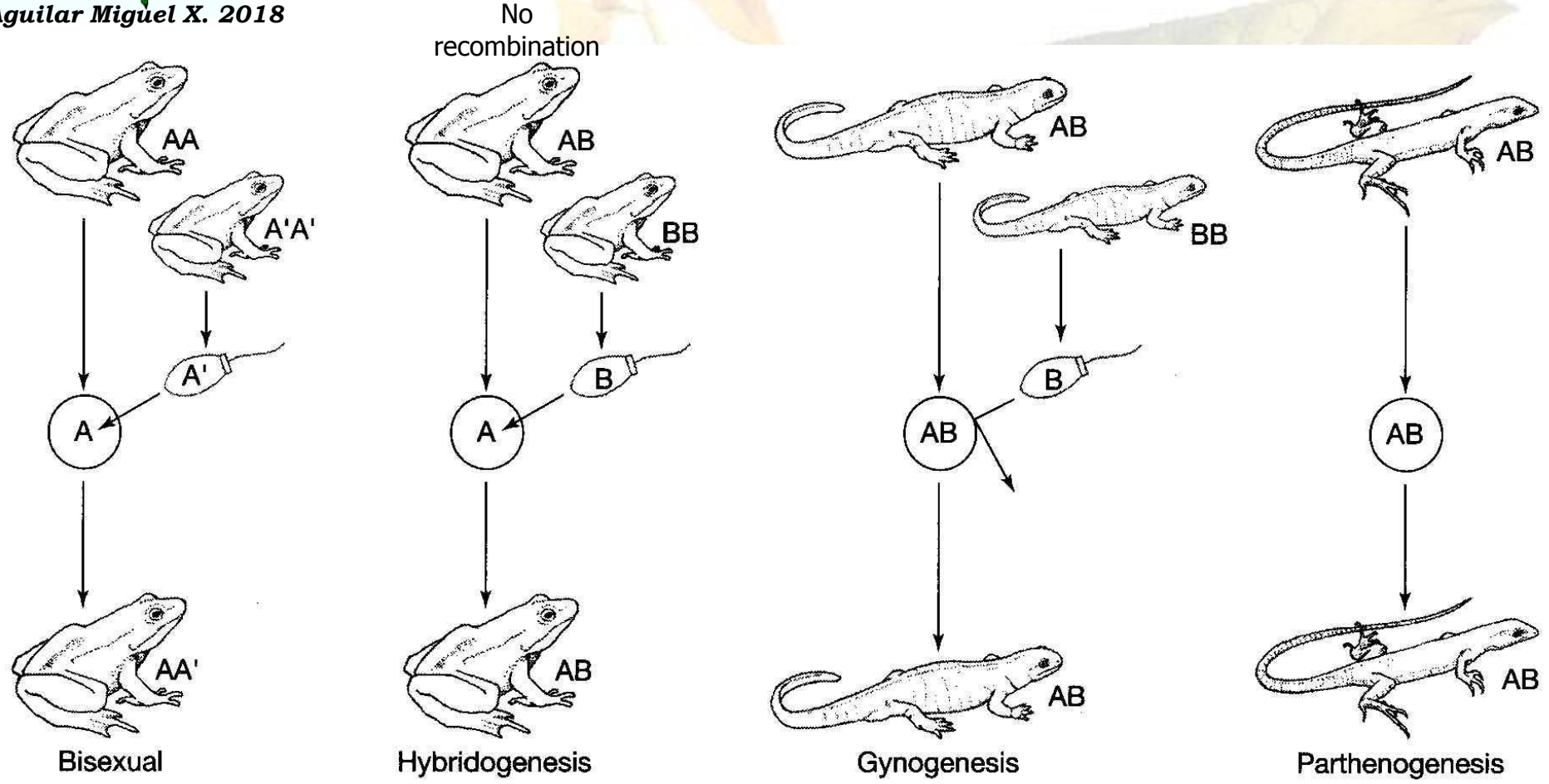
- ❖ ORIGINADOS POR HÍBRIDOS
- ❖ PARTENOGENÉNESIS
- ❖ REPRODUCCIÓN CLONAL
- ❖ Ej. *Rana* hibridogénesis
- ❖ Ej. *Ambystoma* gynogénesis



REPRODUCCIÓN Sexual vs. Asexual

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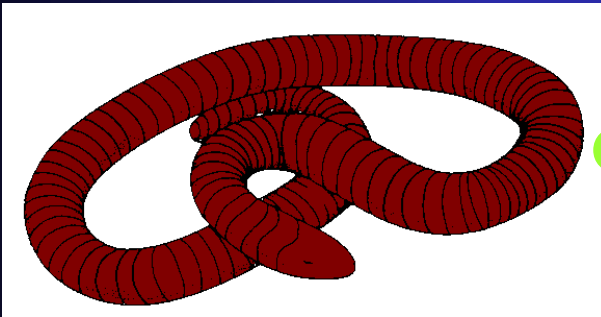
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Pough et al. 2001

CLASE AMPHIBIA

GYMNOPHIONA cecilias

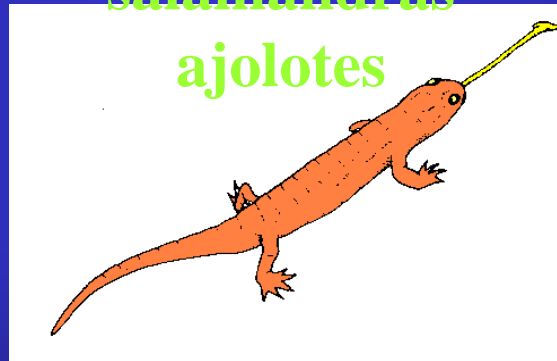


oviparos

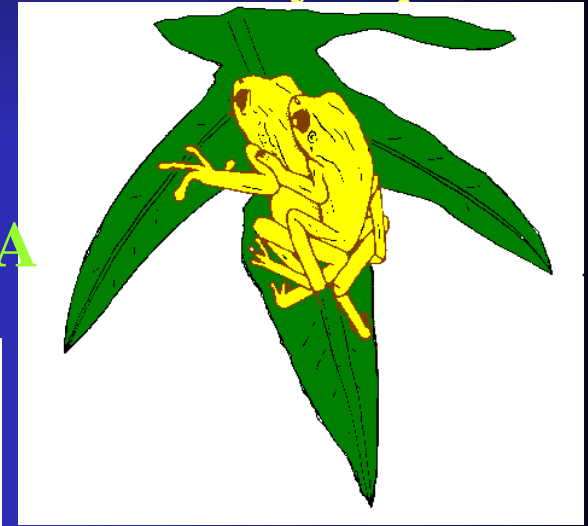
viviparos

CAUDATA/URODELA salamandras

ajolotes



ANURA ranas y sapos



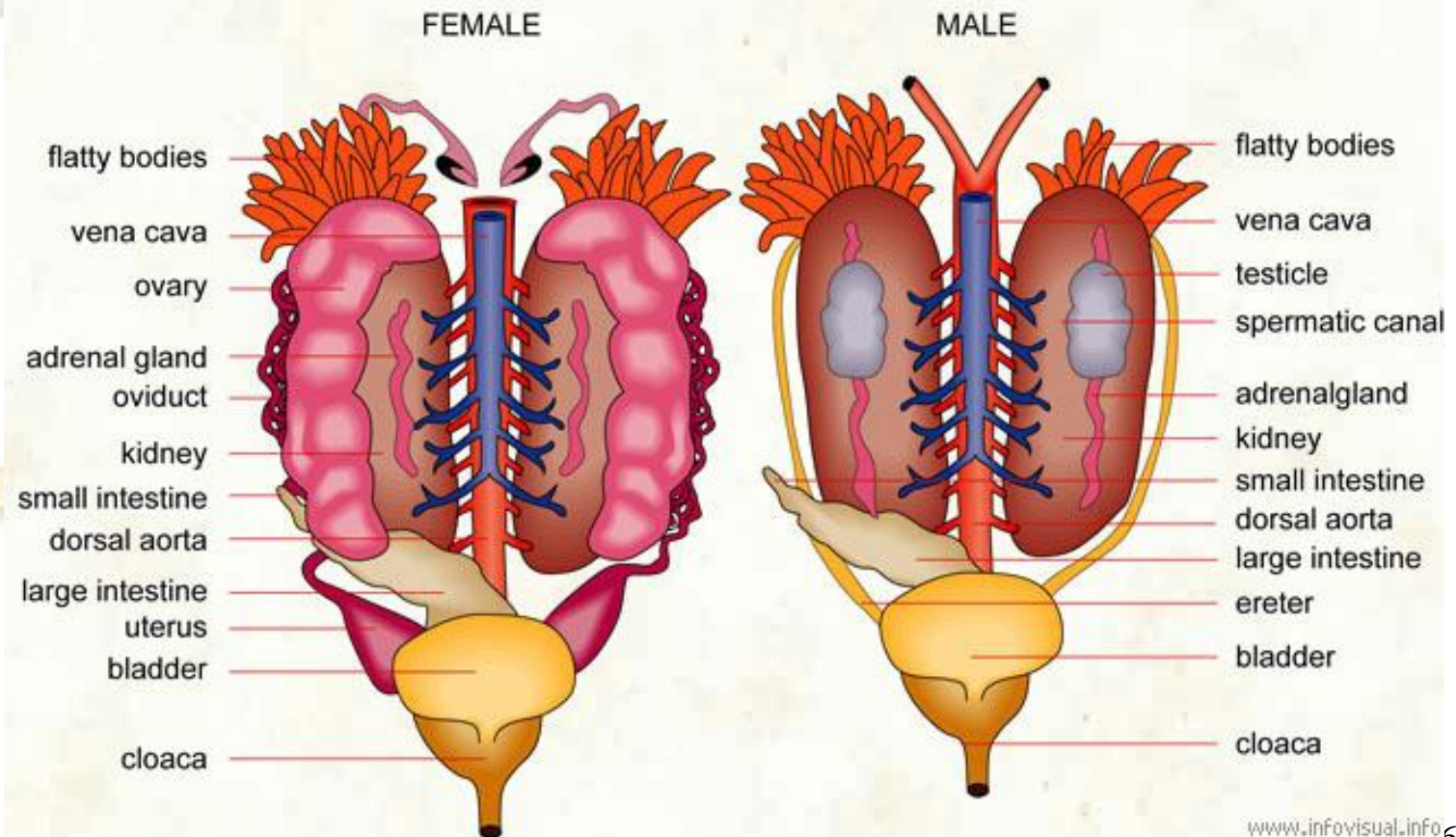


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APARATO REPRODUCTOR

UROGENITAL ORGANS OF THE FROG



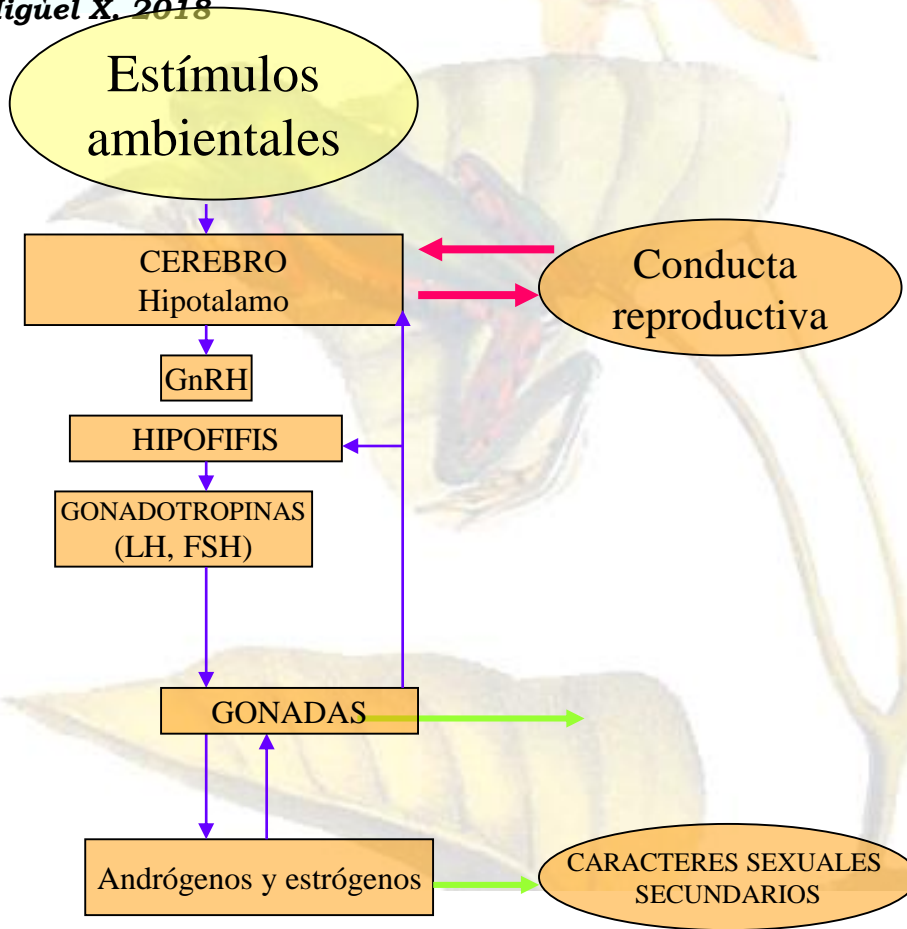


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REPRODUCCIÓN

CONTROL NEURONAL, HORMONAL Y CONDUCTUAL



Fotoperíodo, temperatura, humedad
Espacio, alimento, hábitat
Densidad, población



CICLOS REPRODUCTIVOS

OVÁRICO

ESPERMÁTICO

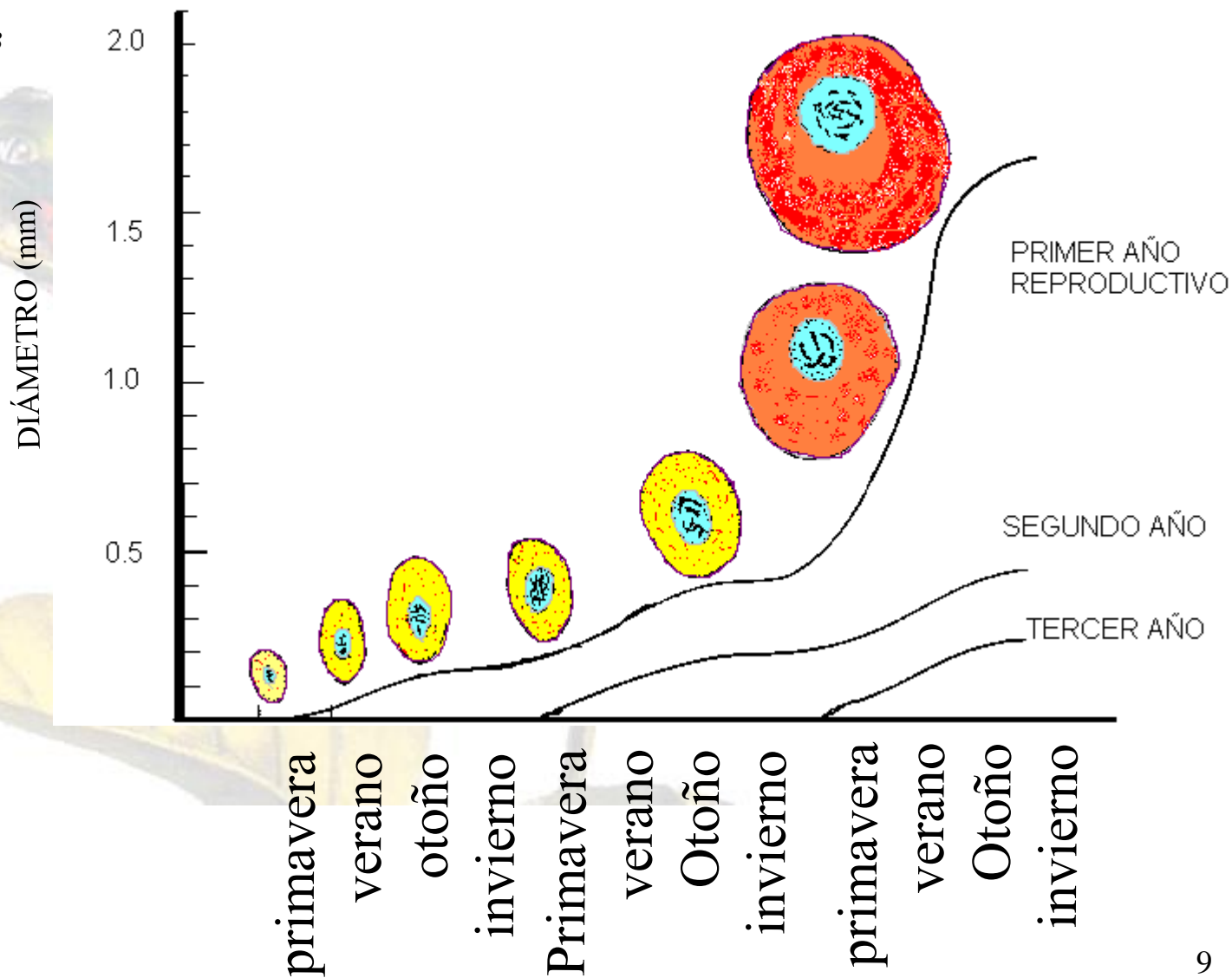
SINCRÓNICOS
ASINCRÓNICOS
ANUALES
BIANUALES



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CICLOS





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CICLO ESPERMÁTICO

CENTRÍPETA O LONGITUDINAL

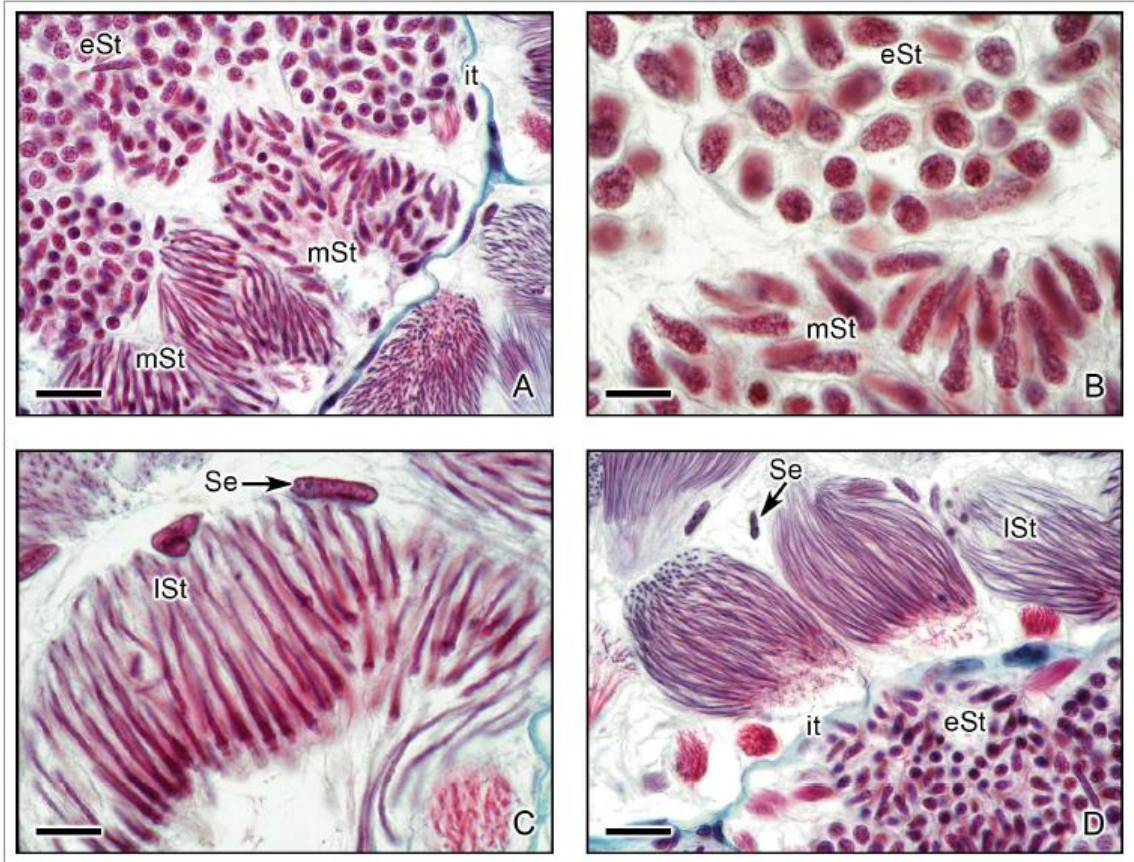
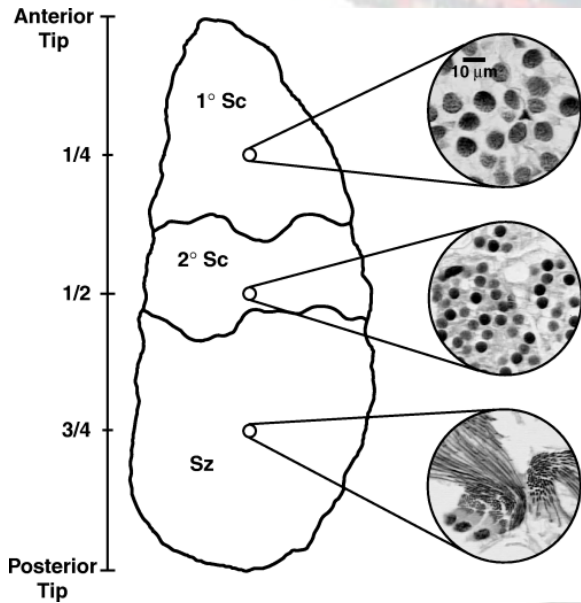


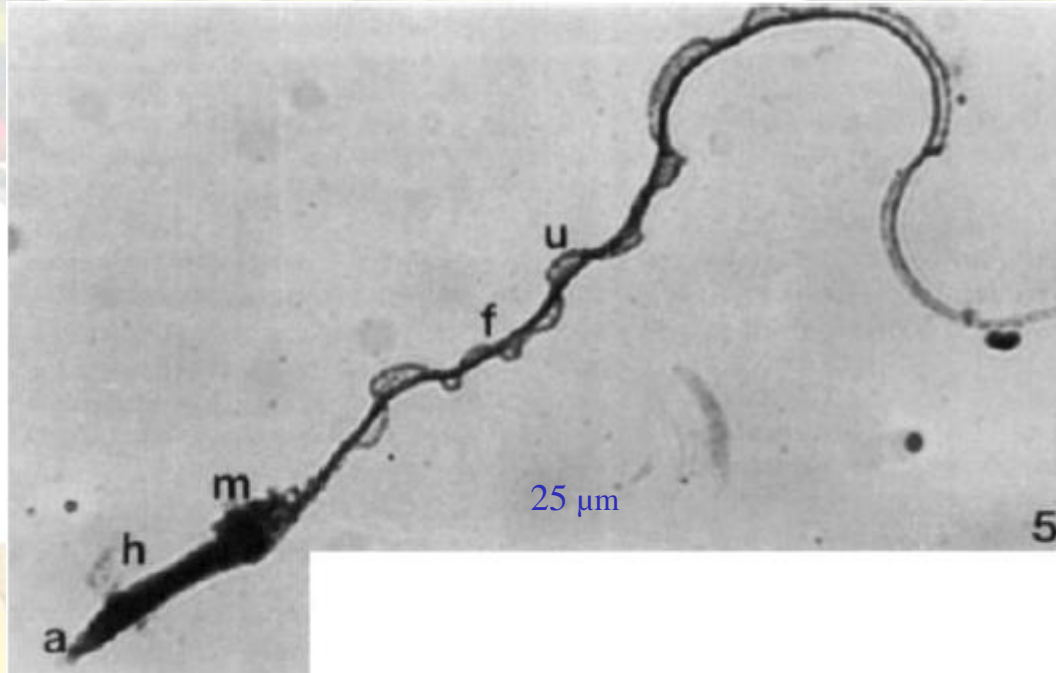
Figure 6. Caudal region of the testis of *Ambystoma dumerilii* (A,C,D) and *A. mexicanum* (B) with details of morphological changes of the spermatids during spermiogenesis. (A,B,C,D). Lobules with cysts that contain early spermatids (eSt) with round nucleus, and middle spermatids (mSt) with different levels of elongation of the nucleus and late spermatids (lSt) with evident and progressive elongation. Sertoli cell nuclei (Se) surround the cysts, interstitial tissue (it). (A): Masson's trichrome. Bar = 10 µm. (B): Hematoxylin-eosin. Bar = 10 µm. (C,D): Masson's trichrome. Bar = 10 µm.



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ESPERMATOZOIDE DE ANFIBIOS



- a. Acrosoma
- h. Cabeza
- m. Mitocondrias
- u. Membrana ondulante
- f. flagelo

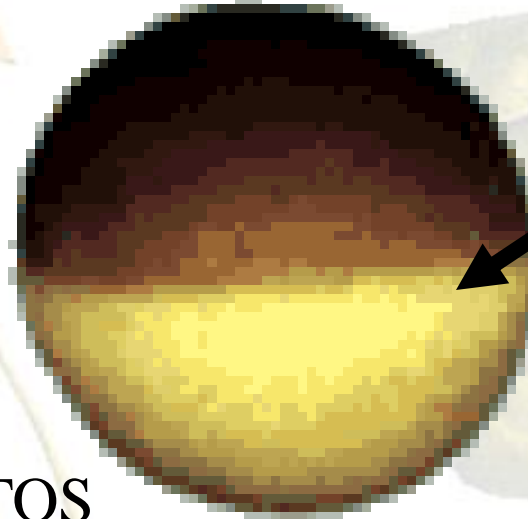
Ichthyophis orthoplicatus
AMPHIBIA: GYMNOPTIONA



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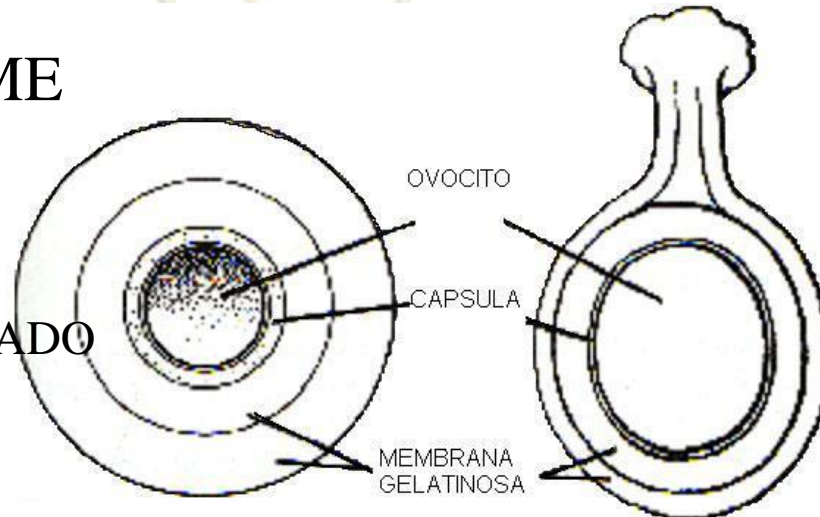
DESARROLLO DEL EMBRIÓN A PARTIR DEL HUEVO ANAMIOTICO



PIGMENTO

HUEVOS DE TIPO OLIGOLÉCITOS
RICOS EN VITELO
DISTRIBUCIÓN UNIFORME

FORMACIÓN DEL HUEVO EN
OVARIO Y OVIDUCTO
VITELO—PRECURSORES DE HIGADO
(VITELOGÉNESIS)



DIMORFISMO SEXUAL



Ambystoma granulatum

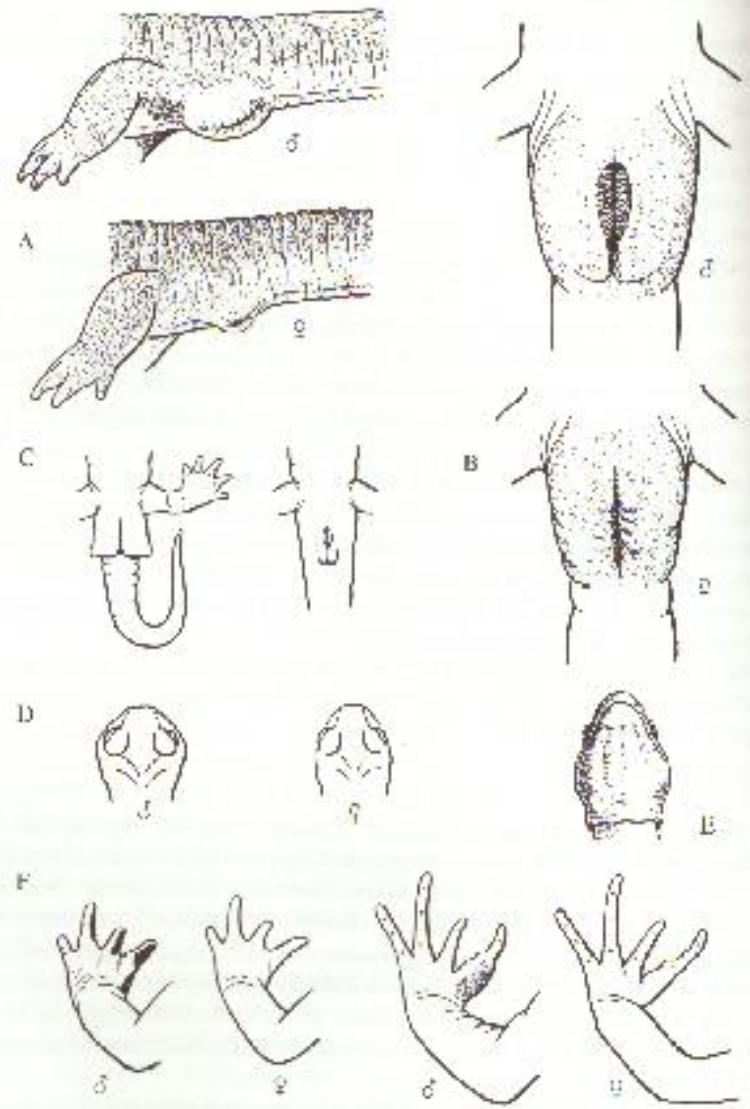


CARACTERÍSTICAS SEXUALES

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Taricha granulosa



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Litoria gracilentata

Hydromantes

Aneides

Bufo

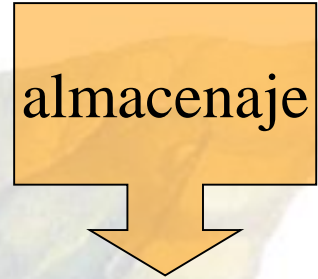
Rana



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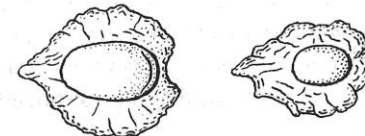
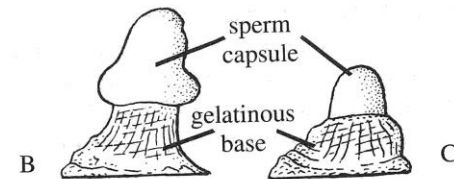
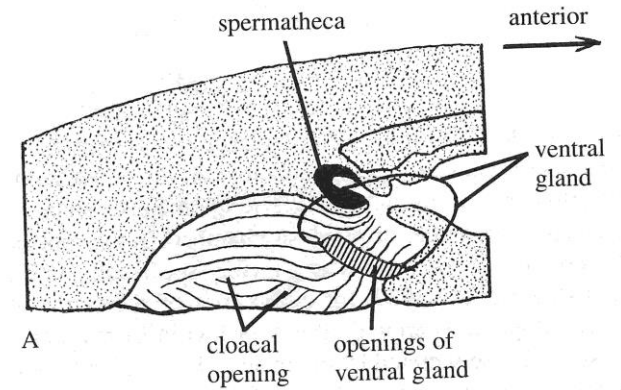
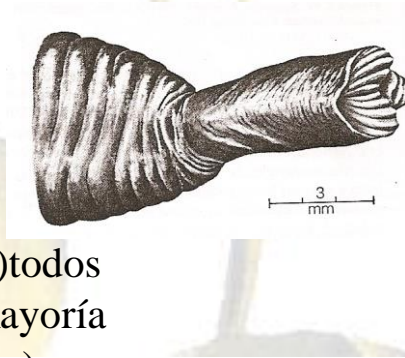
AMPLEXO



FERTILIZACIÓN
 CECILIAS-FECUNDACIÓN INTERNA 100%
 SALAMANDRAS 90% INTERNA
 ANUROS 98% EXTERNA

EXTERNA (CARÁCTER ANCESTRAL)
 INTERNA

CECILIAS- organo intromitente (phalodeum) todos
 SALAMANDRAS -ESPEMATÓFORO la mayoría
 ANUROS- APOSICIÓN DE CLOACAS (5 sp)



Plethodon



TIPOS DE AMPLEXO

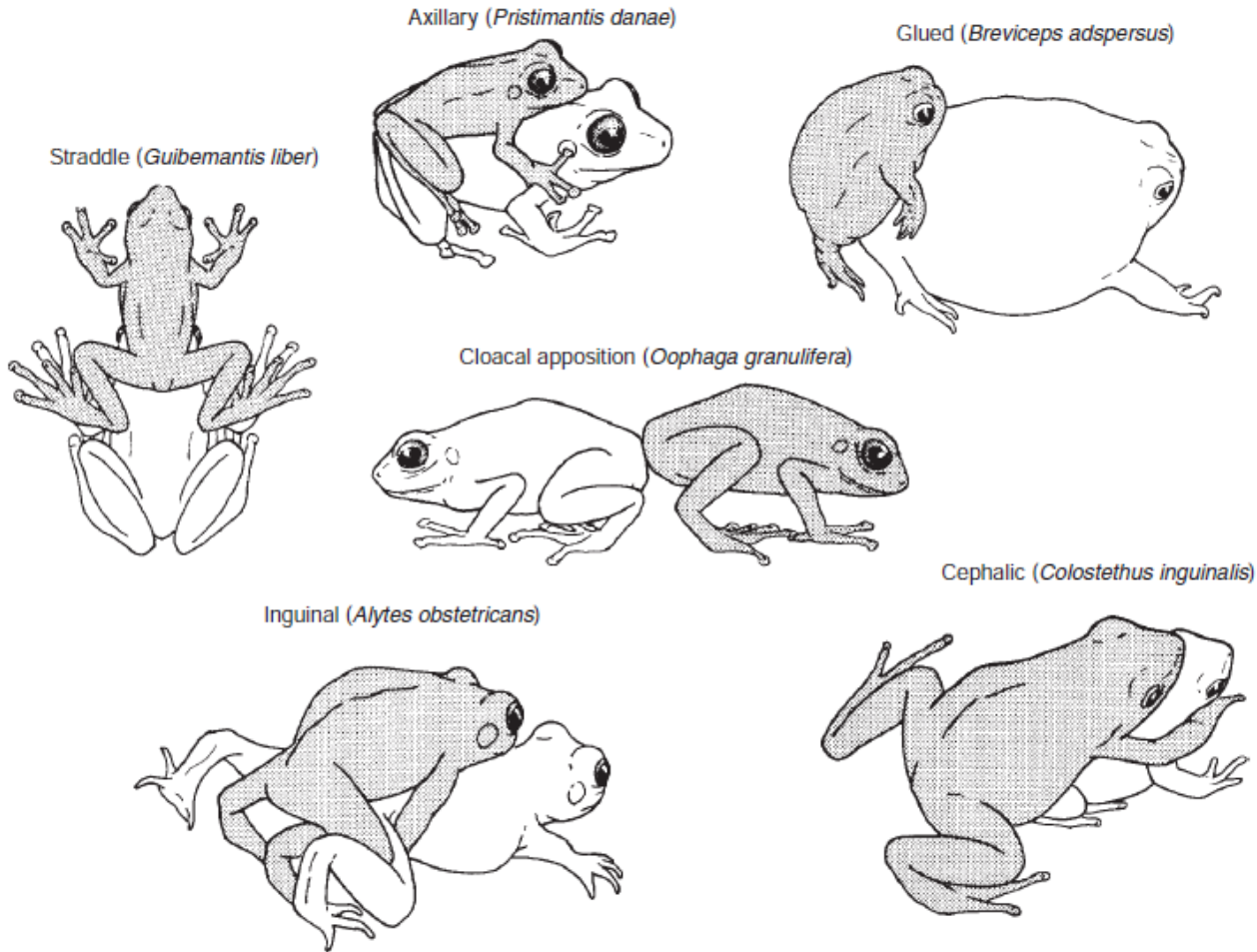


FIGURE 4.8 Positions used by frogs during amplexus. Adapted from Duellman and Trueb, 1986.



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CORTEJO

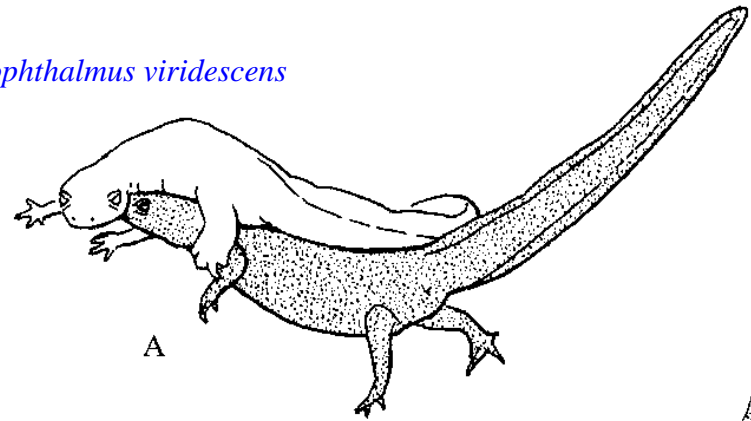
“AMPLEXUS”

¿COMO SE LLEVA A CABO EL RECONOCIMIENTO?

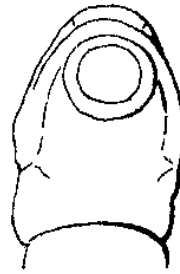
¿MARCAJE DE TERRITORIO?

¿DIRECCIÓN Y/O CONDUCCIÓN PARA EL ENCUENTRO CON EL ESPERMATÓFORO?

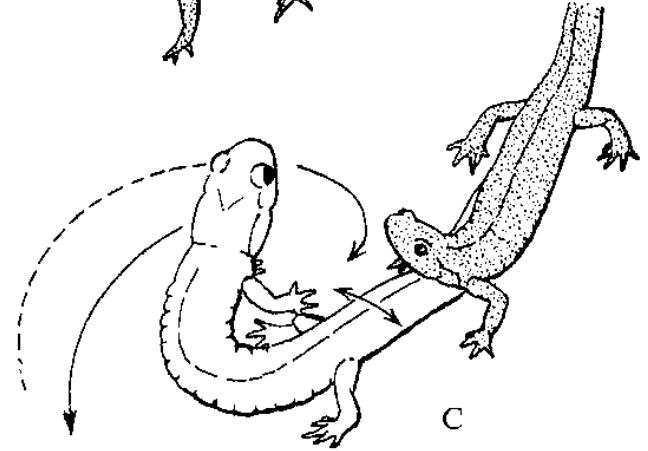
Notophthalmus viridescens



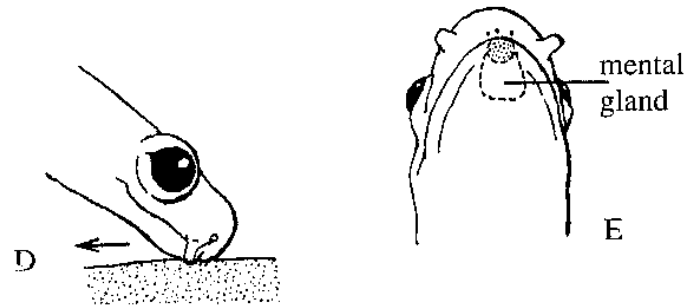
A



B



Plethodon jordani

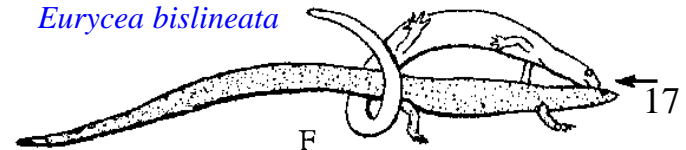


D

mental gland

E

Eurycea bislineata



F

17

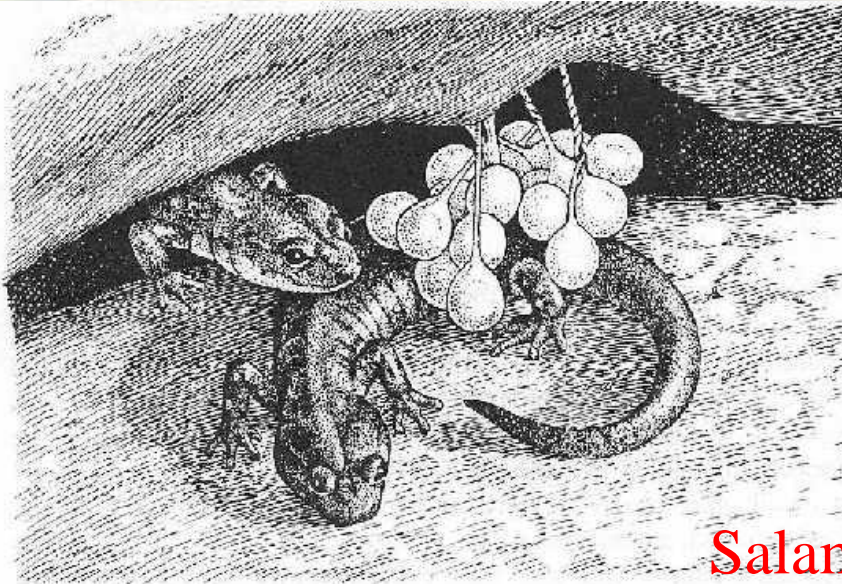


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CUIDADOS PARENTALES

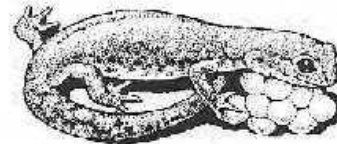
costos y beneficios



Cecilias –100%

Salamandras—cuida ~20%

Anuros—diverso <10%





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Table 7-1 Distribution of genetic sex determination (GSD) and temperature-dependent sex determination (TSD) in amphibians and reptiles. Patterns are summarized for each family in which the condition is known. XY and ZW systems indicate male and female heterogamety, respectively. Data indicate only the occurrence of each pattern in particular families. Only those families for which GSD or TSD have been studied are listed.

Taxon	GSD: Heterogamety	TSD	Taxon	GSD: Heterogamety	TSD
Urodela			Emydidae	ZW, XY	Yes
Ambystomatidae	ZW	No	Kinosternidae	—	Yes
Plethodontidae	ZW, XY	No	Podocnemidae	—	Yes
Proteidae	XY	No	Pelomedusidae	—	Yes
Salamandridae	ZW, XY	No	Staurotypidae	XY	No
Sirenidae	ZW	No	Testudinidae	—	Yes
Anura		No	Trionychidae	—	No
Bombinatoridae	XY	No	Crocodylia	—	Yes
Bufonidae	ZW	No	Sphenodontida	—	Yes
Discoglossidae	ZW	No	Squamata		
Hylidae	XY	No	“Agamidae”	Yes	Yes
Leiopelmatidae	ZW, OW	No	Amphisbaenia	ZW	?
“Leptodactylidae”	XY	No	Anguidae	—	Yes
Pelodytidae	XY	No	Boidae	ZW	No
Pipidae	ZW	No	Colubridae	ZW	No
“Ranidae”	ZW, XY	No	Elapidae	ZW, ZZW, ZWW	No
Testudines			Gekkonidae	ZW, ZZW, XY, XXY	Yes
Bataguridae	ZW, XY	Yes	Iguanidae	XY, XXY, XO	?
Carettochelyidae	—	Yes	Lacertidae	ZW, ZZW	?
Chelidae	XY	No	Pygopodinae	XY, XXY	—
Cheloniidae	—	Yes	Sauridae	XY, XXY	No
Chelydridae	—	Yes	Telidae	XY	No
Dermatemydidae	—	Yes	Varanidae	ZW	?
Dermodochelyidae	—	Yes	Viperidae	ZW	No

DETERMINACIÓN DEL SEXO GENÉTICO (DSG)

MACHOS
HEMBRAS

XY
ZW OW

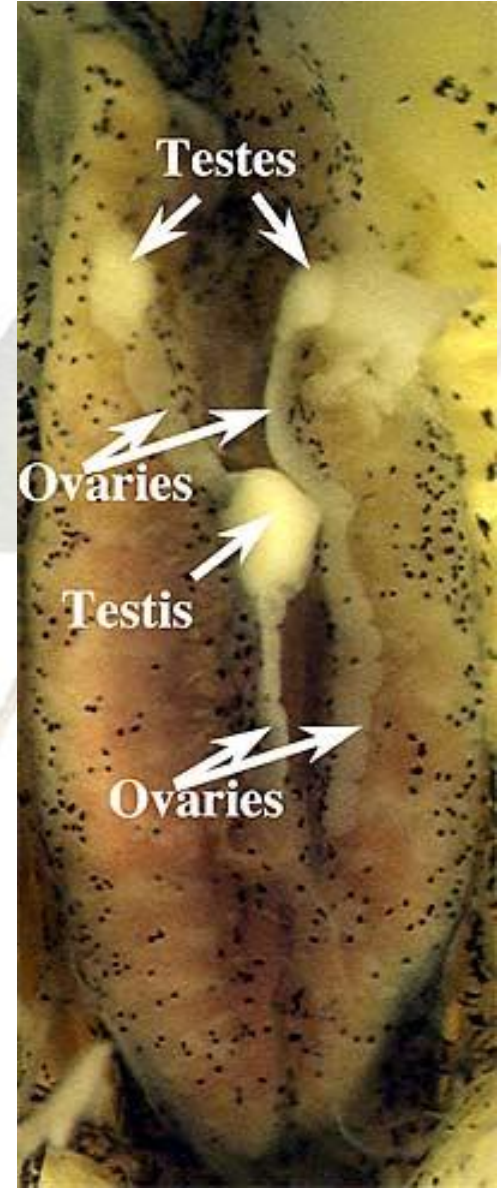


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ANOMALÍAS DE LA REPRODUCCIÓN

CAUSA DE DECLINACIÓN



Abnormal gonads in a male *Xenopus* frog, the result of exposure to the herbicide atrazine. The frog has become a hermaphrodite, that is, it has both male (testes) and female (ovaries) sex organs.²⁰ Credit: Tyrone Hayes/UC Berkeley, courtesy PNAS



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**CARACTERÍSTICAS
DE REPRODUCTORES**

**PROPORCIÓN
DE SEXOS**

**ESTRATEGIA
REPRODUCTIVA**

ARRIBAMIENTO

**SITIOS
DE
APAREAMIENTO²¹**





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CICLO DE VIDA Y MODOS REPRODUCTIVOS

HUEVO → LARVA → ADULTO

DESARROLLO DIRECTO
Eleutherodactylus

PAEDOMORPHOSIS
PEDOMORFOSIS

Notophthalmus

Presenta un estadio juvenil “eft”



Notophthalmus viridescens (Eastern Newt)



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ESTRATEGIAS REPRODUCTIVAS

PUESTA DE LOS HUEVOS
SOBRE UN RÍO



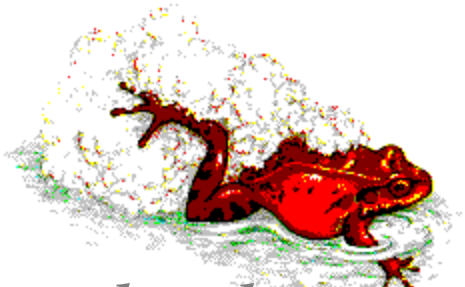
Centrolene

TRANSPORTE DE RENACUAJOS



Dendrobates

NIDO EN ESPUMA



Leptodactylus

INCUBACIÓN ACUÁTICA



Pipa



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ESTRATEGIAS REPRODUCTIVAS

INCUBACIÓN TERRESTRE



Frectonotus

VIVIPARISMO



Nectophrynoides

DESARROLLO DIRECTO



Eleutherodactylus

INCUBACIÓN GASTRICA



Rheobatrachus



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Aguil

HERMAFRODITISMO:



Bufo bufo
Órgano Bidder's
Machos y hembras
Forman ovarios funcionales
En determinadas circunstancias
Independientemente del sexo
Genéticamente establecido

??
"hermafroditas"

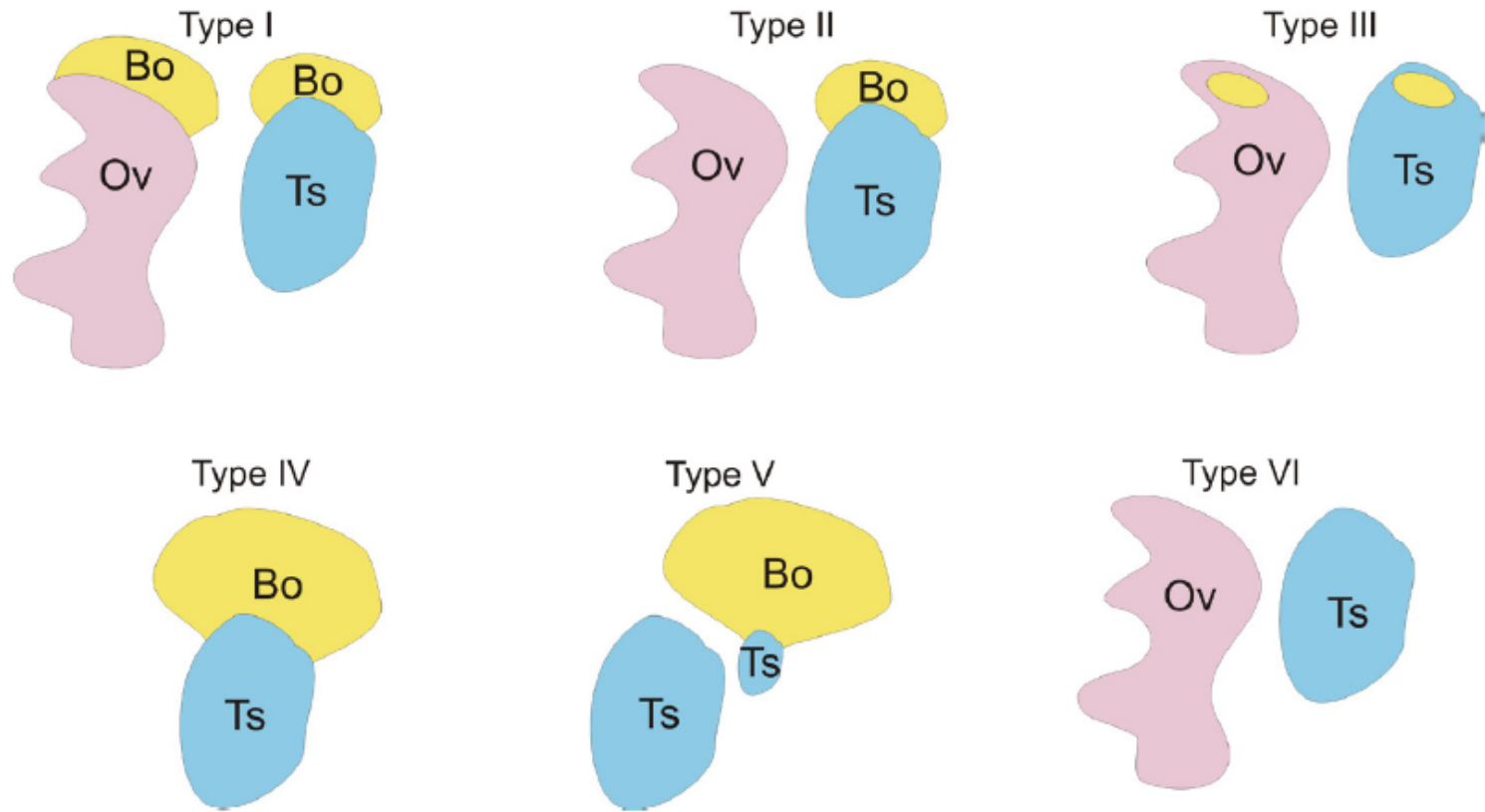


Fig. 1. The diversity of the external morphology of Bidder's organs and gonads among bufonids. (Type I) The Bidder's organs (Bo) are present at the anterior poles of ovaries (Ov) and testes (Ts). The presence of Bidder's organs in both adult males and females was described in *Bufo bufo*, *Bufo americanus*, *Bufo terrestris*, *Bufo quercicus*, *Bufo ictericus*, *Pseudophryne bibronii*. **(Type II)** The Bidder's organs presence only in males, and its disappearance in adult females is characteristic for *Bufo viridis*, *Bufo marinus*, *Bufo lentiginosus*, *Bufo canorus*, *Bufo fowleri*, *Bufo vertebralis*, *Bufo rosei*, *Bufo angusticeps*, *Bufo garipeensis*, and *Nectophrynoides viviparus*. **(Type III)** The Bidder's organ incorporation into the adult ovaries and testes was described in *Bufo melanostictus*, *Bufo fowleri*, *Nectophrynoides occidentalis*. **(Type IV)** In some *B. woodhousii* males the Bidder's organs are well-developed and resemble the ovaries. **(Type V)** In some *B. arenarum* males the testes with well-developed Bidder's organs are smaller than the testes lacking Bidder's organs. **(Type VI)** In *Melanophryniscus* and *Truebella* the Bidder's organs are absent.



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Estructura Organo de Bidder's ovocitos en estadios tempranos de desarrollo en hembras y machos. En adultos en hembras degeneran

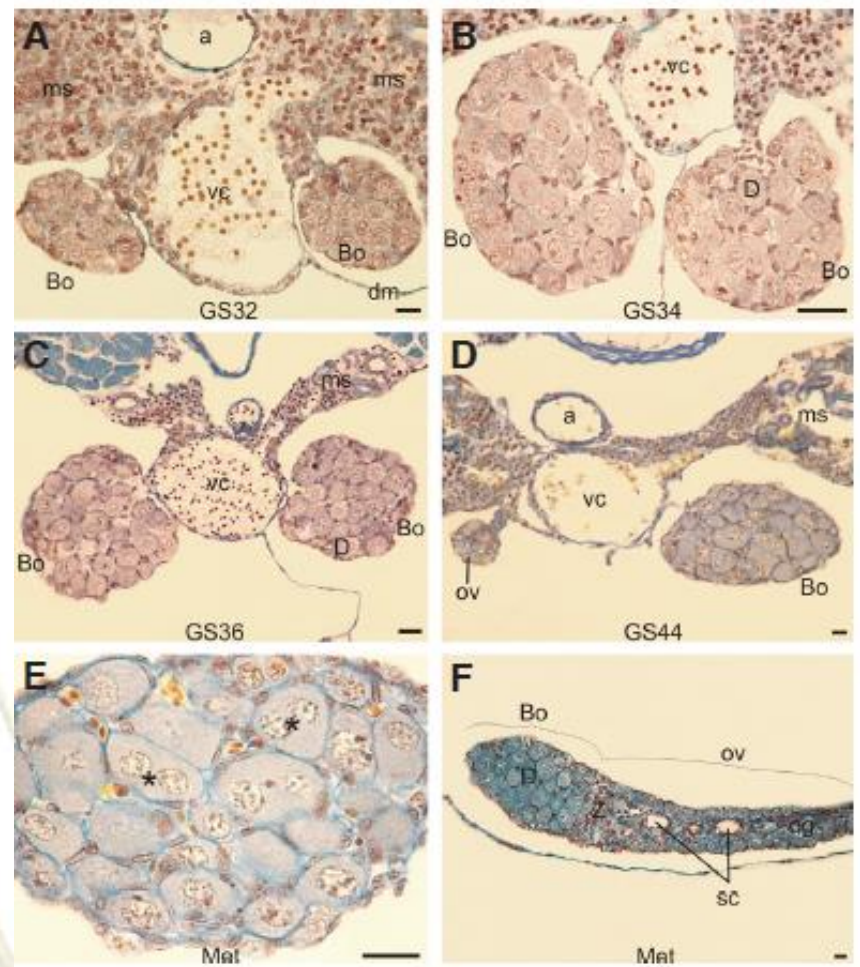


Fig. 2. The structure of developing Bidder's organ in *Bufo viridis*. (A-E) Cross sections through Bidder's organs at subsequent Gosner stages (GS32 to metamorphosis, MET). (D) Cross section through the ovary (left gonad) and the Bidder's organ (right gonad). (E) Cross section through the Bidder's organ just after metamorphosis containing diplotene oocytes; asterisks indicate binuclear oocytes. (F) Longitudinal section through the Bidder's organ (Bo) and the ovary (ov); diplotene oocytes (D) are present in the Bidder's organ, oogonia (og) in the ovary, and the zygotene oocytes (Z) in the transitional retrobidderian region between the Bidder's organ and the ovary. During the development of the Bidder's organ in tadpoles, the germ cells enter diplotene and bidderian follicles form. a - aorta, dm - dorsal mesentery, ms - mesonephros, sc - secondary cavity in the ovaries, vc - vena cava. Debreuill staining, scale bar is equal to 30 μm .



Estrategias en Dendrobates

- *Epipedobates bilinguis*
- Rana venenosa Ecuatoriana
- Pone los huevos y si se secan orina para humedecerlos.
- Los machos generalmente suelen transportar a las larvas a bromelias con agua para completar su desarrollo.





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Estrategia en ranas marsupiales

- *Rheobatrachus silus* y *Rheobatrachus vitellinus*
- Ranas australianas
- Comen sus huevos y realizan una incubación gástrica (estómago)
- Completan la metamorfosis en 8 semanas, cuando emergen de la boca de su madre
- ¿Cual es la estrategia?
- No come
- No sintetiza jugos gástricos, mediante la secreción de protraglandinas
- El estómago funciona por ese periodo como útero.

Rana de Australia
Rheobatrachus silus
Extinta en el siglo XX



artimalia.org «No podemos resucitar animales con un lápiz, pero si podemos dibujarlos y contarte la historia de su vida y extinción»

Dibujo: Rafa Garabal
Para Artimalia
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DESARROLLO LARVAL Y METAMORFOSIS

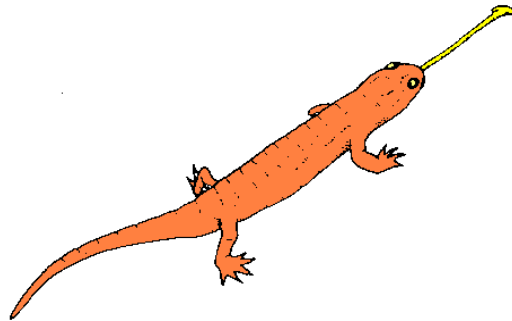
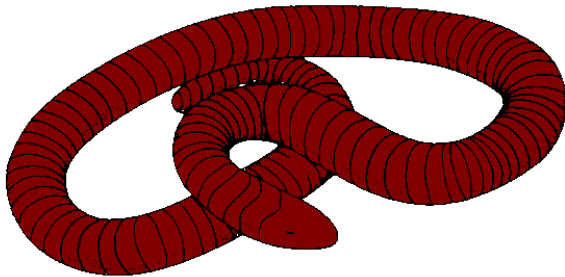
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ANURA
ranas y sapos

GYMNOPHIONA
cecilias

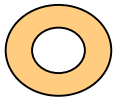
URODELA
salamandras
ajolotes



SE PARECEN AL ADULTO
CON BRANQUIAS

SE PARECEN AL ADULTO
CON BRANQUIAS, DENTICIÓN LARVAL
LA MAYORÍA CARNÍVOROS

VARIABLE
DIAS O AÑOS COMO LARVA
METAMORFOSIS ES DRAMÁTICA
SIN ALIMENTARSE MIEMTRAS OCURREN
CAMBIOS EN AP. DIGESTIVO,
RESPIRATORIO, CIRCULATORIO, EXCRETOR
OSIFICACIÓN ETC. 30





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Guión

El presente material didáctico, es para el empleo en la Unidad de Aprendizaje HERPETOLOGÍA, basado en el programa de la Licenciatura en Biología de la Facultad de Ciencias, Universidad Autónoma del Estado de México.

Tiene como objetivo, dar a conocer al estudiante los aspectos relevantes de la Biología Reproductiva en Anfibios, considerando algunos ejemplos de caso, integrando el concepto de especies y las particularidades de cada proceso biológico.

Se integra el material en dos partes, siendo esta la primera parte donde se desarrollan los aspectos generales de la reproducción en anfibios.

NOTA: ILUSTRACIÓN DE IMAGEN INCORPORADAS DE LA WEB, SIN FINES DE LUCRO PARA ACTIVIDAD DOCENTE